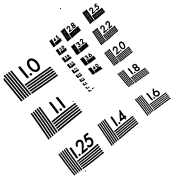

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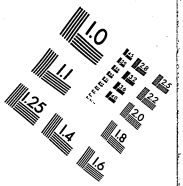

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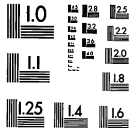

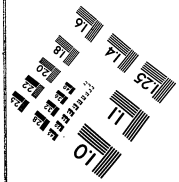

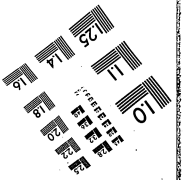

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THOMAS A. EDISON PAPERS

A SELECTIVE MICROFILM EDITION
PART II
(1879–1886)

REEL 32

NOTEBOOK SERIES (NBK–10)

Menlo Park Notebooks, #33 – #46

Menlo Park Notebook #33 [N-79-01-00]

There are no dated entries in this notebook. The book probably dates from 1879. Most of the entries are by Francis Upton. There are also entries by Edison and Charles Batchelor. The material by Upton consists of notes, drawings, and calculations relating to electric lighting costs, lamp and generator tests, generator design, and electric power distribution. The material by Edison includes calculations and drawings of regulators, notes on tests with an electric engine, and calculations relating to lamps. There are also notes by Batchelor on tests of a small dynamo and notes by an unknown laboratory assistant on experiments to determine the conductivity of various substances. The book contains 282 numbered pages.

Blank pages not filmed: 208-211, 270, 273.

Missing page numbers: 271-272.

No 83.

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120 BROADWAY, NEW YORK.

_____, 189

(141) 1 1

Cinbolite Ag (Cl Br.) Silver City New Mexico

No indication

(386)

Chabazite

no current

19 Allemontite Sb. As.

It offers no resistance

184 Hercynite

no current

179 Corundum Al.

no current

198 Uraninite Pitchblende

when I pressed down with my fingers I got a resistance of about 20 ohms. When I put it in the clamps and

2 brought it down to about 14 ohms. I pressed it down again with my fingers and it gave hardly any resistance this time which is perhaps due to the moisture coming on one side.

231 Blendeite
no Current

Galena (n B. 15
no Current

217 Earthy Cobalt
no Current

34 Pyrolusite
no Current

293 Arsenic Mispickel
no Current

1 Gold Ore
no Current

231 Quartz Smoky
no Current

247 Bytownite
no Current

204 Hatchite ? ?
no Current

271 Van Rensselaerite
no Current

203 Diaspore
no Current

054 Kupfernickel
no Current

3

171 Aegirite Magnetic Ore
no Current

22 Sulphur
no Current

237 Wollastonite
No Current

55A Wavellite
No Current

415 Samarskite
no Current

58 Pyrite
No Current

321 Amethyst
No Current

718 Magnesite + Hypomagnesite
no Current

183 Spinel
no Current

69 Braunerite
no Current

98 Sylvanite no current

47H Columbite no Current

192 Cassiterite no Current

231 Quartz
No Current

386 Chabazite
And current

178 Samarskite
No Current

175 Columnite
no Current

346 Chrysocolla
no Current

401 Cyprite
no Current

351 Datolite
no Current

49 Horseflesh Ore

when pressed with the hand it gave a resistance of about .12 ($\frac{12}{100}$) of an ohm with the clamps it went down to about .99 ($\frac{99}{100}$)

225 Stibiconite

when pressed with the hand it gave a resistance of about .2 ($\frac{2}{10}$) of an ohm. when with the clamps it went to .12 ($\frac{12}{100}$) of an ohm

87 Allemanite

When pressed down with the hand it gave a resistance of about .07 ($\frac{7}{100}$) with clamps a little less.

186 Loadstone

with Clamps it gave a resistance of about .4 ohms

17 Arsenic

when pressed with the clamps it gave a resistance of .08 ($\frac{8}{100}$) of an ohm.

83 Smaltite

Gave a resistance of about .06 ($\frac{6}{100}$)

64 Cinnabar
[illegible] gave a resistance of about 700 ohms

198 Smaltite
one piece gave me a resistance of about 200 ohms & another [illegible]

222 Figure Stone
no Current

269 Garnet
no Current

474 Uvarovite + 290 Lepidomelane
no Current

29 Stilbite It looks as if it had a metal, but gave it [illegible]
no Current

447 Jeffersite
no Current

716 Dolomite
no Current

610 Wolframite
no Current has the looks of a metal + is heavy

10.

231 Staurolite
no Current

H01 Hypersthene
no Current

205 Limonite
no Current

2[illegible] Mica Group
no Current

798 Iron Oxide
no Current

422 Aggimatolite
Kaolin
no Current

[illegible] Magnetic Ore
no Current

38H

Schorlomite
no Current

It comes as effect were as ore for is heavy.

272 Zircon
No Current

231 Agate
no Current

551 Magnetite
no Current

678 Pleonaste
no Current

193 Rutile
It is heavy and looks like a metal, but gives no current.

Graphite
No Current

Hematite
No Current

Ferromonite
No Current

Azurite
No current

Cerrusite
No Current

Pennimite
No Current

Pyromorphite
No Current

227 Cervantite

I got a deflection, but could not measure the resistance it being above 100000 ohms.

2 Silver (Lake Superior)

I got a resistance of about .01 ($\frac{1}{100}$) of an ohm

276 Epidote

Got a deflection, but resistance above 1000 ohms

178. Melaconite

Got a deflection, but resistance above 100000 ohms.

21 Tellurium native

gave resistance of about 1000 ohms.

40 Marcasite
about 4000 ohms resistance

44 Cubanite
about 1/5 of an ohm resistance

122 Boulangerite
about 150 ohms

No Current

458 Enargite
No Current

916 Orthoclase
No Current

838 Grahamite
No Current

278 Idaite
No Current

153 Hessite
On some parts of the surface when I apply my wires to it gives hardly no resistance while there are parts where I cannot get any current at all.

56 Sphalerite
No Current

715 Calcite
No Current

584 Vivianite
No Current

125 Dimagnetite

Dr gave me a resistance of about 2½ ohms.

125 Tetrahedrite

gave resistance of about 250 ohms on some spots, while more or less on other parts

97 Protoferrimuscite
no current

293 Muscovite
no current

558 Phyllite
no current

247 Amphibole
no current

320 Mica
no current

400 Talc
no current

710 Anthophyllite

891 Jet no current

1115 Halide
no current

724 Aragonite
no current

6514 Gypsum
No Current

715 Calcite
no Current

916 Cabonate
no Current

44 Hæmatite
It gave a resistance of about .08 of an ohm.

81 Limonite
It gave a resistance of about .1 of an ohm. It seems to be pure ore.

91 Leucopyrite
It gave me a resistance of about 3 ohms.

64 Cinnabar
It gave me a resistance of about 400 ohms

916 Orthoclase (Red)
no Current

715 Calcarious Tufa
no Current

186 Magnetited muscovite
no Current

999 Talc
no Current

271 Garnet
no Current

420 Hallingite
Put a dot on the [illegible]

4

4 Elmore Mountain Rock
no Current

247 Amphibole
no current

231 Quartz (Rose colored)
no Current

715 Calcite Ca C
no current

749 Hydrozincite
no Current

181 Manganaxinite
no Current

276 Epidote
do Current

231 [illegible]

[illegible]
no Current

631 Celestite
do Current

715 [illegible] Ca C
gives no current tests
here & there [illegible]
of Tinnacite Lead with Cu dust
Crystals

232 Opalized Wood
no Current

291 Garnet
no Current

231 Petrified Wood
no Current

30 [illegible]
no Current

205 Tourmaline
no current

285 Anthracite
no Current

73 [illegible]
no Current

3 [illegible]
no Current

Othoclase
no Current

5H Phonolite (Cap)
no Current

5b Ca[illegible]
Dog below cap
no current

10 [illegible]
[illegible]

157 Smelt [illegible]
[illegible]

210 Glaucophane
[illegible]

269 Cyanite
[illegible]

322 [illegible]
no current

263 Hulfenite
no Current

5

189 Corundum
no Current

236 Delevitz
no Current

275 Calcite (Carb)
no Current

419 Kassiterite

23 Agalmyd (wood)
no Current

217 Heulandite
Current

411 Antillite
no Current

184 Cu[illegible] Pachysandra Kaempferiae
.. No Current

185 Nop[illegible]
No Current

186 Bienaeeaeuta
No Current

2[illegible] [illegible]
no Current

168 [illegible]
no Current

212 Calorastrobia
no Current

16 Dolo[illegible]
no Current

[illegible] Epipsorical Ecta
No Current

[illegible] Nephe[illegible]
no Current

148 Frankenia
[illegible]

[illegible] [illegible]
[illegible]

237 [illegible]
[illegible]

256 Fairchildia
No Current

59 [illegible]
[illegible]

45 [illegible]
No Current

183 Euphorbia
no current

71 Bromelia
no current

102 [illegible]
no current

66 [illegible]
no current

181 [illegible]
No Current

218 [illegible]
No current

68 [illegible]
No Current

197 [illegible]
No current

64 Hematite (Fe$_2$)
Gave a resistance of
about 1414 ohms

106 Graphite (C)
It offered hardly no
resistance.

113 Cyprite
It offered [illegible]

Cuprous [illegible]
It gave a resistance
of about [illegible] ohms

77 Zincite
It gave me a resistance
of about 240 ohms.

32

33

176 Amalgames

191

bb

50-

193 Laboratoire

194 Institut

106 Bismuth

7 Limestone
no Current

283 Chalk no Current

24# Flint
no Current

17 Basalt, Diorite &c
no Current

95 Andesite
no Current

Calcareous Grit
no Current

14 Sphaerulite
no Current

190 Arragonite
no Current

11 Quartz (Calcareous)
no Current

(a) Channel Grit
no Current

14 Quartz
no Current

6 Quartz
Clear Crystal
no Current

63 Granite
no Current

26 Perroquet

281 Sirène Quartier

14 [illegible]
Eyre
[illegible]

142 Hématite
No Current

144 Amphibolite

52 Calcaire
No Current

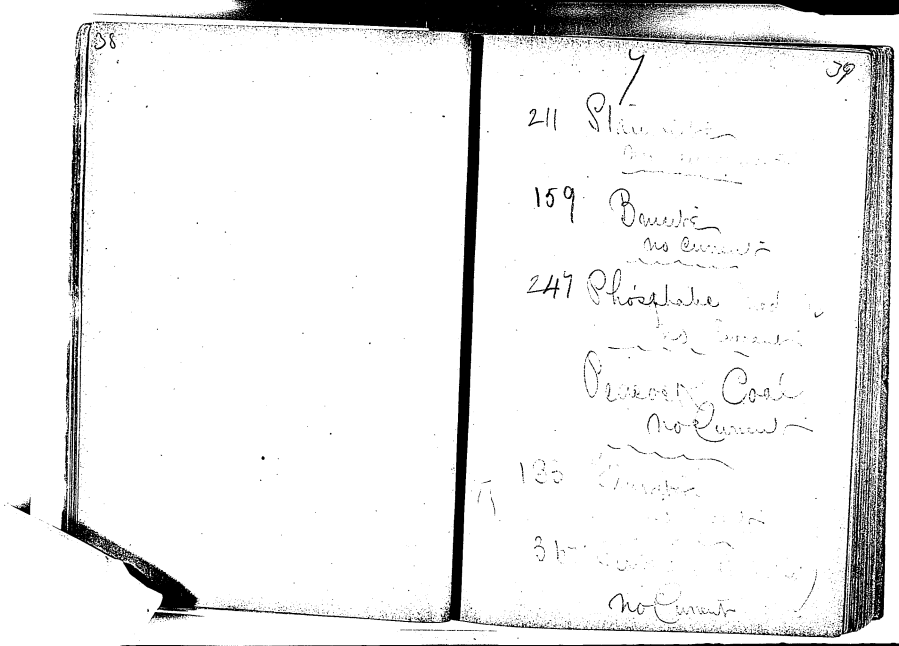
44 Chrysocolla
[illegible] Current

206 Tourmaline
[illegible] Current

98 [illegible] (Cuesta Co.)
[illegible]

459 It offered for a short
[illegible]

243 Seybertite
It is [illegible]
Have [illegible] graphite +
Cannot get a current
through it — doesn't



215 Chabazite
No Current

247 Prehnite
No Current

51 Barite
No Current

131 Fluorite (Ca F)
No Current

314 Diopside
No Current

139 Calcite Ca C
No Current

214 Chabazite
No Current

300 Diabantite
No Current

188 Biotite
No Current

187 Amphibole
No Current

Cossyrite
(Var Augite)
No Current

222 Glauconite
No Current

273 Calcite
(Needle head Spar)
No Current

286 Magnesite
No Current

280 Calcite
[illegible] no Cimetière

202 Craquelé
du Cimetière

185 Marneux
du Cimetière

816 Schisteux
du Cimetière

200 Marneuse
du Cimetière

191 Marneuse
du Cimetière

45 Calcaire ou Pierre
[illegible]

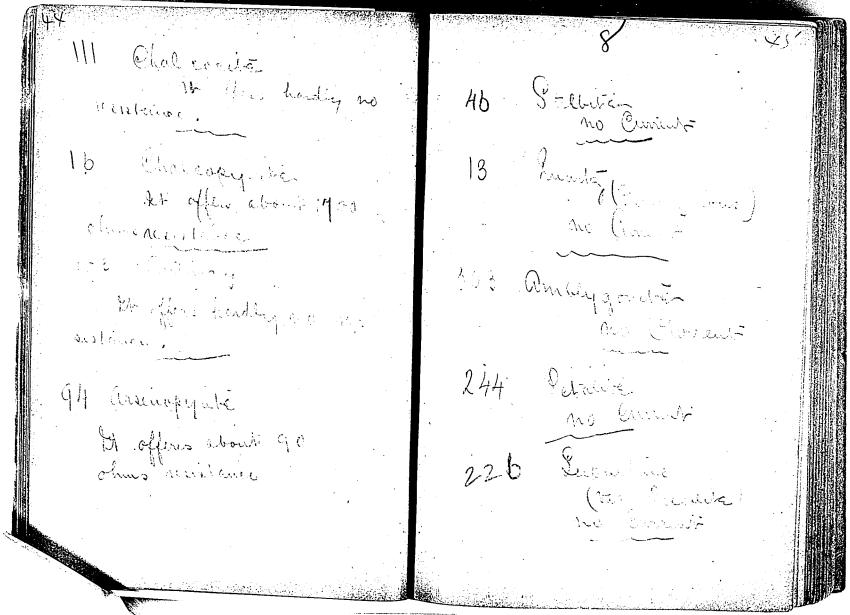
161 [illegible]
[illegible]

316 [illegible]
[illegible]

187 Marneux
[illegible]
du Cimetière

156 [illegible]
[illegible]

252 [illegible]
[illegible]



111 Chalcocite
It has heating no resistance.

1b Chalcopyrite
It offers about 17 ohms resistance

94 Arsenopyrite
It offers about 90 ohms resistance

8

46 Sphalerite
no Current

13 Pyrite
no Current

233 Arsenopyrite
no Current

244 Petzite
no Current

226 Galena
no Current

29 Beryl
No Comment

No Comment

No Comment

No Comment

No Comment

No Comment

48 Alexite
No Comment

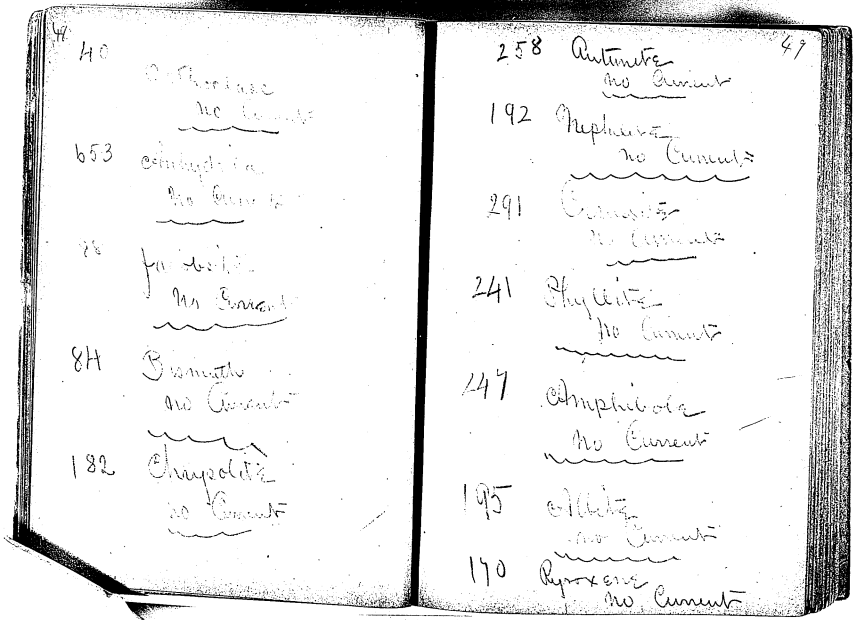
166 Apatite
No Comment

464 Chrome Diopside
No Comment

202 Corundum
No Comment

282 Cuprite (Cu2O)
See Structure

209 Cyanite
No Comment



by Pyrite

[illegible] a resistance
of about one & one half
ohms."

Capacity

It gives [illegible] and
resistance.

Magnetic Test

It gives [illegible]

[illegible]

By [illegible]

232

235 Dauvit

No Current

Syphilis

No Current

Various records

No 1 Barely any resistance

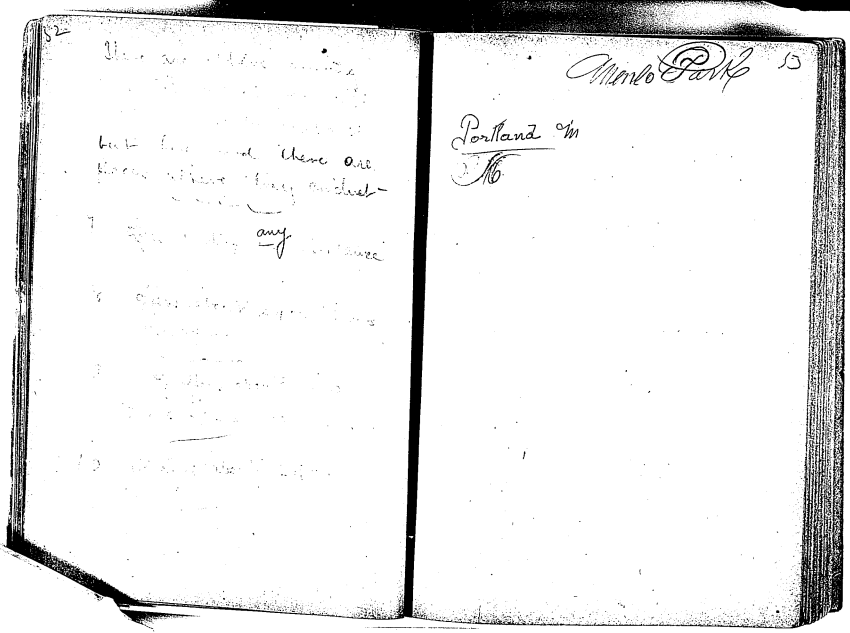
No 2 It offers about 47 ohms resistance

No 3 It offers about [illegible] ohms resistance

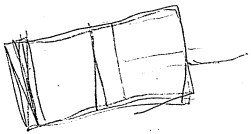
No 4 It offers about 7,000 ohms resistance

No 5 About 300 ohms resistance

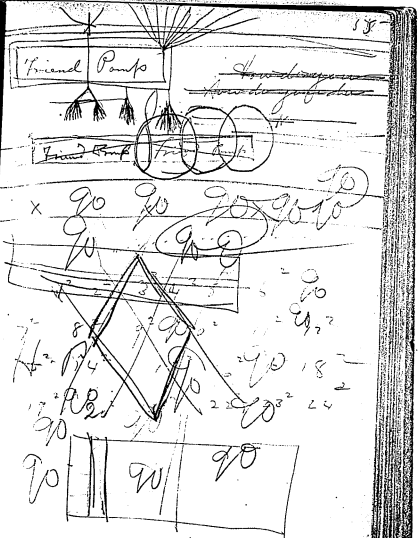
No 6 It offers about 9,000 ohms resistance



Hour-glass



Friend Pump



Test with Electric Engine & governor for opening circuit to regulate the Coil energy passing in a circuit.

Slow Speed

4 cells	deflection	3
5	"	4
6	"	4 1/4
7	"	4 1/2
8	4	4 1/2
9	"	5

Raised governor arm 1/8 inch

3 cells.	deflection.	7
4 "	"	4
5 "	"	7
6 "	"	5
7 "	"	6 1/2

8 deflection 3-½ 58
9 "

still further up.

3	Cells	– def	6 @ 7
4	"		6 @ 7
5	"		6 @ 7
6	"		6 @ 7
7	"		6 @ 7
8	"		6 @ 7
9	"		5-[illegible]

¼ inch higher up -

3	Cells	– def	22
4	"		0
5	"		10
6	"	"	10 ½
7	"	"	

60

~~Up fi~~

Up higher still oiled it = 61

3 cashs	def	21
4 "	"	8 1/2
5 "	"	5
6 "	"	7@8
7 "	"	6@7
8 "	"	5@6
9 "	"	6@7

Very high up —

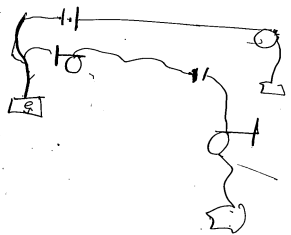
3 - cashs -	deflection	9
4 "	"	9
5 "	"	8 1/2
6 "	"	6@7
7 "	"	7
8 "	"	7
9		6@7

Put on stiffer spring on governor

3	Cells.		19 @ 20
4	"		.14
5	"		17
6	"		16
7	"	———	15 @ 16
8	"	———	14 @ 15
9	"	———	13

Put stronger spring on long fence

3	Cells -	dont work governor	—
4	"	difficult	18@19
5	"	"	14
6	"	"	12
7	"	"	13@14
8	"	"	16@17
9	"	"	16@17



Put governor up as high as it would go - don't open lever.

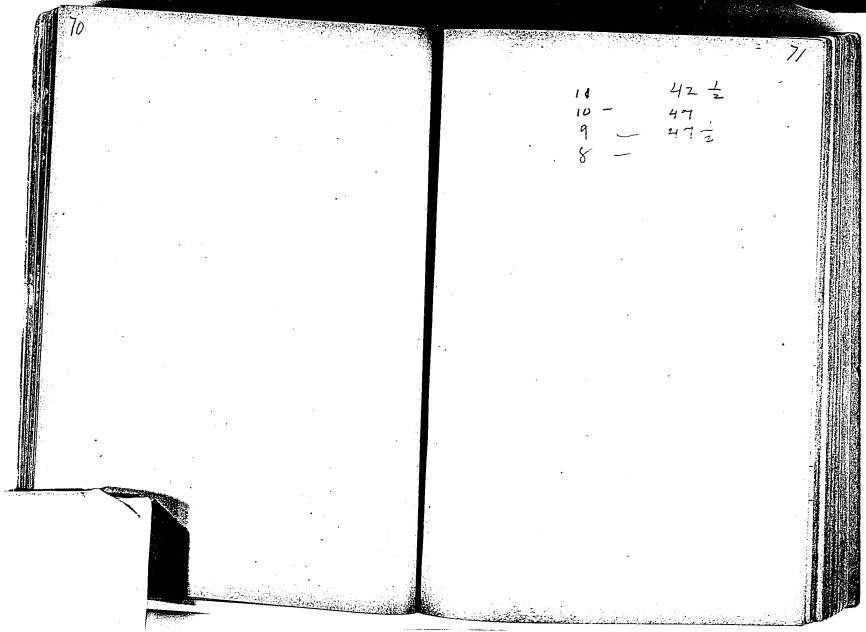
3	Cells	25
4	wires burn slightly -	25 ½
5	Cells work your ole —	29
6	" "	19.
7	" "	15
8	" "	15
9	" "	16

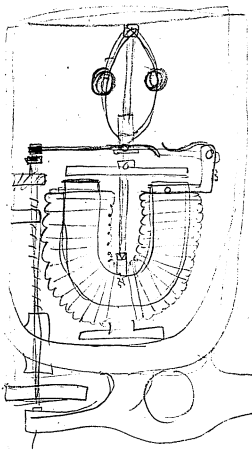
Shunted Engine Magnets with, 2 ohms

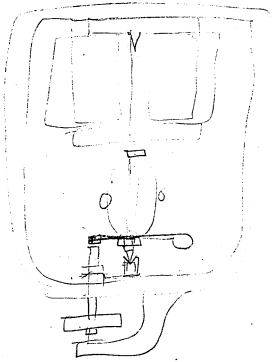
3	——	29
4	——	31 1/2
5	"	36 1/2
6	"	39 1/2
7	"	40.
8	"	40
9	"	39-
11 Cells —	——	36

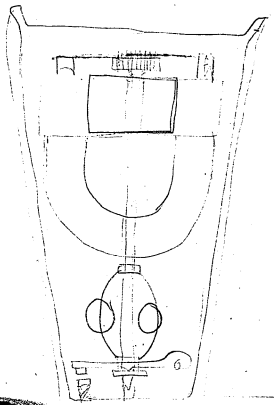
Shunted with 1 ohm –

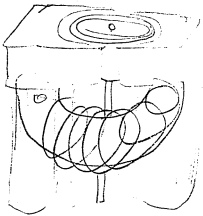
		deg
3	cells –	31
4	" –	36
5	" –	40
6	" –	42
7	" –	45 –
8	" –	46 ½
9	" –	– ? –
10	–	49 ½
11	–	50 – ½


70
71
11 42 1/2
10 — 47
9 — 47 1/2
8 —









96.1
139
1.9

940
57
28

76.9
231

757
243

73.5
765

66.7
33.3

71.4
286

62.5
375

[illegible]

Without limiting Score 781
219

56 1/2 with limiting

Score - 29 1/2

849
151
75

83.4
466

79.3
207

926
74
37

87.7
123
617

90.9
91
45

895
105
52

82
18
9

806
194
97

86.2
138
69

Limiting Screw Tension Spring Governor

3	ozs lbs	29 2
4	"	27
5	"	33
6	"	33
7	"	34
8	"	34
9	"	34
10	"	34
11	"	33.

984 / 16

97.1 / 29

take the Gracic step of Centre
at ~~9~~ 9 it goes incredible
goes to 15-

(Smith) Marq. ☆
.5 alum.

Qnt goes to 60 11 Cells.

11 Cells.	60 ½
9	0 @ 61
8	60
7	58.
6	NG

Mag Eng Shunt 1½ ohm 85-

11 cells — 50

10 45

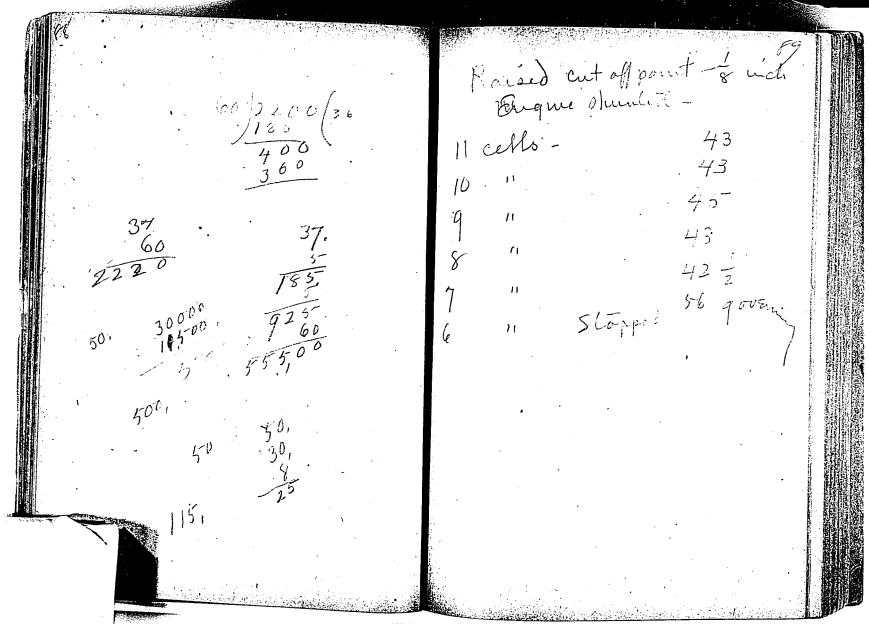
946	93	917
54	47	83
27	3.5	41

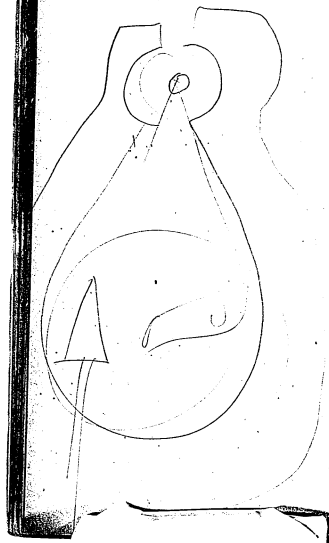
916
44
22

745
255
127

Fixed Eng.

11	cells -	49
10	"	50 ±
9		51
8		51
7	"	50 ±
6	"	47
5	"	40 ±
4	"	48
3	"	50 Stop[ped] [illegible]





Your Cuts off sleeves [illegible]

11 Cuts — 40 [illegible]

10 " [illegible]

9 " 40 [illegible]

" 45

7 " 45

6 " 40

5 " 40 [illegible]

4 " [illegible]

Balls [illegible]

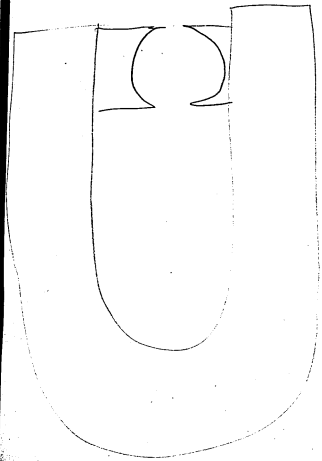
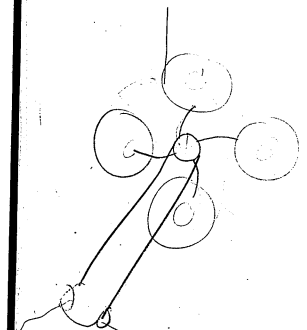
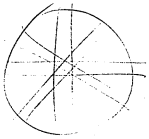
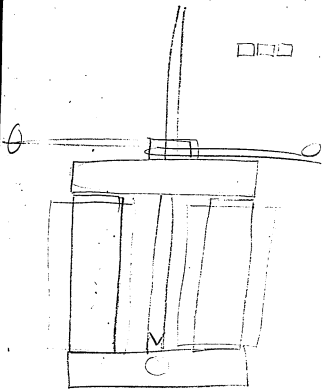


fig 19 a



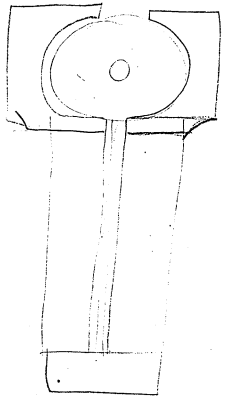


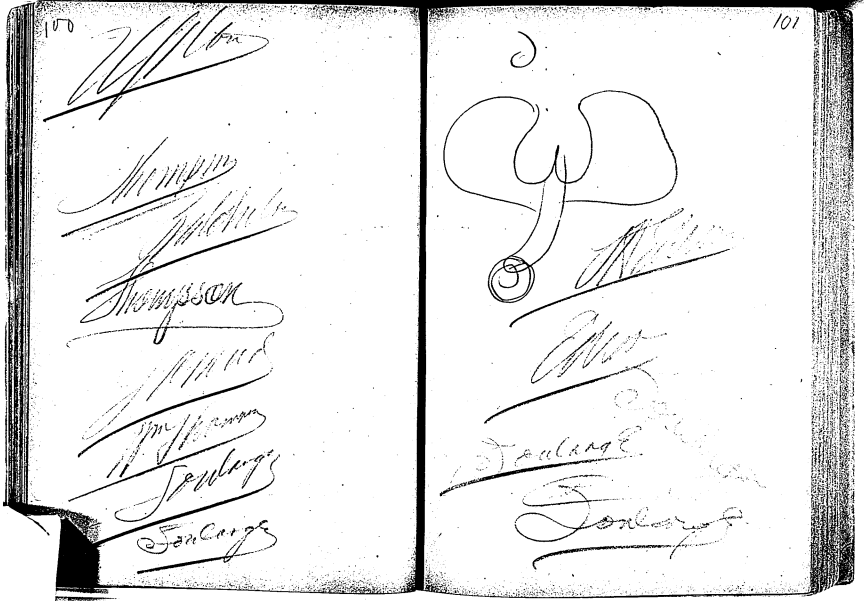


Upton

Portland

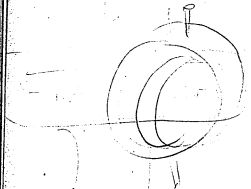
Batcheller





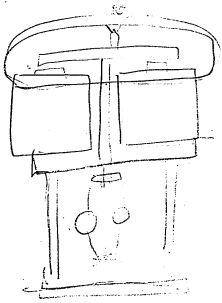
5000

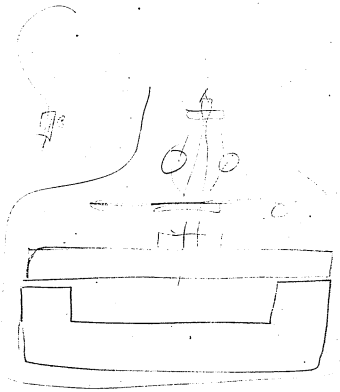
60000
10
600,000



12) 60,000 (5000
60
0

60 000
30
1,800,000





106

$$\vartheta_o = \frac{\mathcal{E} + \mathcal{E}_1}{R + R_1 + r'}$$

$$\vartheta_d = \frac{\mathcal{E} - \mathcal{E}_1}{R + R_1 + r'}$$

$$\vartheta_o + \vartheta_d = \frac{2\mathcal{E}}{R + R_1 + r'}$$

$$\vartheta_o - \vartheta_d = \frac{2\mathcal{E}_1}{R + R_1 + r'}$$

$$\frac{2\mathcal{E}_1}{\vartheta_o - \vartheta_d} = \frac{2\mathcal{E}}{\vartheta_o + \vartheta_d}$$

$$\mathcal{E}_1 = \frac{\vartheta_o - \vartheta_d}{\vartheta_o + \vartheta_d}\mathcal{E}$$

107

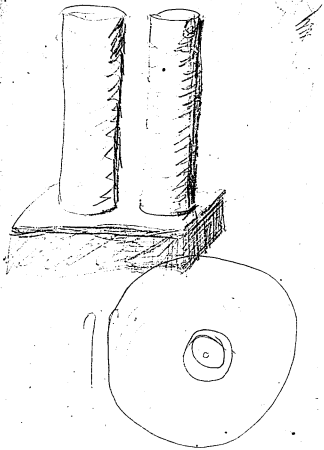
$$\vartheta_1 = \frac{\mathcal{E}}{R + r_1} \qquad \vartheta_2 = \frac{\mathcal{E}}{R + r_2}$$

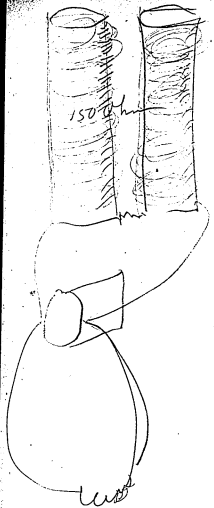
$$R = \frac{\mathcal{E}}{\vartheta_1} - r_1$$

$$\vartheta_2 = \frac{\mathcal{E}}{\frac{\mathcal{E}}{\vartheta_1} - r_1 + r_2}$$

$$\vartheta_2 \frac{\mathcal{E}}{\vartheta_1} + \vartheta_2 \vartheta_1 (r_2 - r_1) = \mathcal{E}\vartheta_2$$

$$\mathcal{E} = \frac{\vartheta_2 \vartheta_1 (r_2 - r_1)}{\vartheta_1 - \vartheta_2}$$

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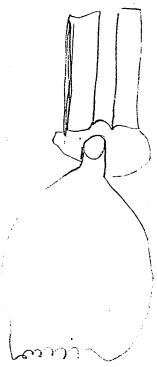


6 1/8 6.125 inches diameter

100 Volts Current

10 Webers

Total resistance = 10 Ohms

felt but 3 feet each

72 inches

No. 10 wire

.134 = D

72 .8572

.132 7.205

545 turns

6.125	0.7871
3.141	.4930
comp 12	8.9208 - 10
45.	2.7364 0.2009
	12.9373
	2.9373

866 feet wire each layer

$\frac{2}{1732}$ on magnets Recover 4/

1737 feet to Ohm

545 turns on one magnet

10 workers

5450 = Strength

100 = Cost

1090 turns on whole

$\frac{10}{10900}$ = strength

100

1000 Ohms

10 100

100

10 cent

$\frac{100 \text{ volts}}{100 \text{ Ohms}}$ = 1 Watt

100 = Cost

No. 16 wire Current = $\frac{1}{10}$ before

.065 in = Diameter

covering .010

Total D = .075 in.

6 feet	72	1.8573
	.075	3.8751
		2.7822

960 turns

1.59 feet in turn

Log = .2009

408.7 feet per Ohm

100 Ohms

40870 . feet

.4.6107
1.2009
4.4098

25700 turns

545 turns before

25700 .4.4098
545 2.7364
1.6634

~~46~~ 23 times the turns
1/10 the current

~~46~~ 2.3 more effective
in

25700 .4.4098
960 2.9571
$\overline{1.4527}$

layers

28.5 1.4527
thickness .075 2.8751
~~5.5778~~
.3278

2.1 inches

12.78 for 1000 feet

40.870 1.6107
12.78 1.1060
2.7167

.521 lbs on
$1.25

Winding only one
magnet

10 Meters over flume

100 unit of E

44.5

4415.0 foot lbs. per minute

33000 4.5185
4450 3.6454
.8701

7.42 per H.P.

H.P cost 1.5 ct per hour

1.5 .1761
7.42 .8701
7.3060

2.03 mills.

2.03 cts. per day 10 hrs

365 days
2.00
1095
730
$7.695 per year

1/2 saved 3.70 per year
2 times per day
5 makes the magnet $37 could afford

In. 10 wire

1700 3200
Ft. 15.44 1.2650
1.9648

92.2 lbs Cu
40 cts per lb
$36.88

Mixed
Record

8 | 22400
2800

1/28

Magnet

Reference

Ans

60

42 000

42 224 | 33
32
92

1200

180
8 | 1500
37

2800
8
22400

80
240

120

200 tons a day

10 men

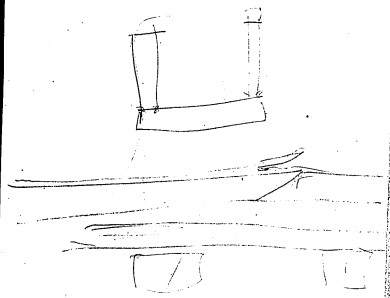
2

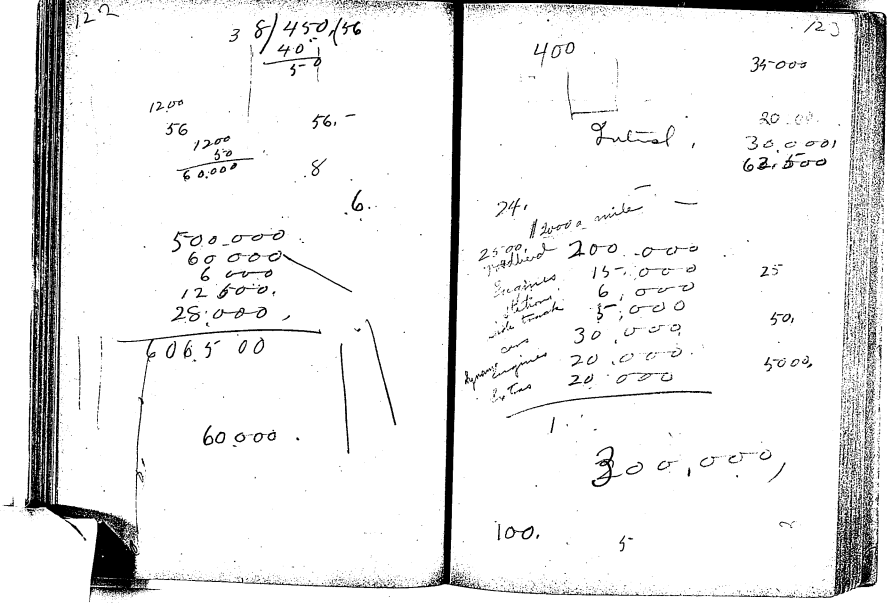
1 20

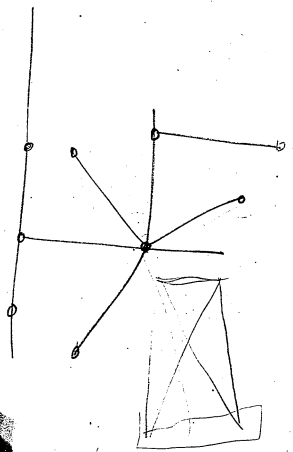
50 / 200

4

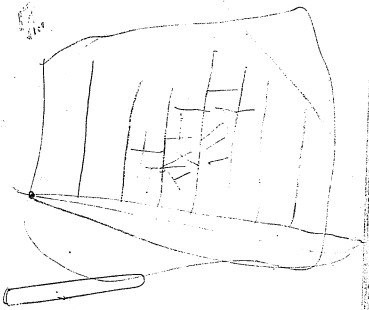
121







30



80.

160,

30

Magnet to have 1 H.P
given it If magnet is used
all day 24 hours

Cost 1 H.P. say 2 cents
the ~~receipts~~ total for one hour

Used for 24 hours
it would be ~~for~~ say 1.5 cent.

1.5	0.1761
24.	1.3802
365.	2.5623
	4.1186

$131.00 a year for H.P.
unit 8 hours a day at 1.5 cents
per hour.

3631
43.66

$ 1746	at 2 cents
$ 131.	at 1.5 "
$ 87.33	at 1 cent

In a magnet using 1 H.P
to run ~~$~~ 1/2 that is so
that a machine could
run 1/2 the power and be
equally efficacious, there can
be ~~saved~~ saving to this to bring 10% interest.

$ 873.3.	at 2 cents
$ 655.5.	" 1.5 "
$ 436.6.	" 1 cent

Rule to run a H.P

$ 1746	can be spent
1316	
873	

used all the 24 hours

1746
1316
873

Maid 12 hours there can be about

573.3
65.5.
436.

1746 3.24 88
24 1.38 12

816
65 28 1316 3 11 93
24 1.38 12

1.9.16

1.78 71

Maid 10 hours
816.
615
408

61.5
40.8.

615
8
4920

Maid 8 hours
852.
492.
326.

Maid 4 hours.
326
246
163

Maid 1 hour
81.6
61.5
40.8

3 feet long 0.125 in. ϕ

2 6 feet long

No. 8 wire .165
14
.179 in. Diam

6.1125 0.7871
3.141 0.4935
Sum's 12. 8.9208
.2014

1.59 ft. in one turn

6 feet = 72 in 72. 1.8573
Sum's .179 10.7471 −10
2.6744
403 turns 1.59 .2014
2.8058

639 feet of No. 8 wire in one layer

12.14 feet per ft

639 : 2.8058
12.14 1.0845
1.7213

52.6 lbs

= .2633 feet per Ohm

2.8058
2633 3.4205
7.2852
.242 Ohms

2 layers 806 turns
1278 feet
105 lbs
.492 Ohms

No. 9. Wire

.148 = .0
14
.162

15.1 feet in 1 lb
2119 feet in 1 Ohm

72 1.8573
cross .162 1.2095
2.6478
444 turns .2014
2.8492
707 feet 15.1 1.1770
468 lbs 1.6702
2.8492
2119 3.3261
1.5231
.333 Ohm
1332 turns to 1 Ohm

.007126 2.1475
140

No. 10 Wire

.134
.014
.148

72. 1.8573
.145 ÷ .1703
2.6870
.2014
2.8884
1.2651
1.6233

486 turns
773 feet
18.41

42. lbs

2.8884
3.2399
1.6485

.1737.

.445 ohms

2.6870
1.6485
3.0385

1090 turns to an Ohm

10106

94 lbs per Ohm @1.9747

136 Mr. H Hines

.120
13
.133

72
.133
Turns 541

860 feet
22.95
37.5 lbs

1.85-73
7 12 34
2.73334
20 14
2.9348
1.3608
1.5740

2.9348
1392.
.618 Ohms
3.1437
1.7910

2.7334
1.7910
2.9424
876 Turns to an Ohm

see Book 31 p. 91

.0164
1.7852
61.

No. 5 Wire

4681.1 feet per Ohm

.00145-9 — 3.1641 — 2.8359

685 lbs per Ohm

No. 6 3985. feet per Ohm

.002012 — 3.3036 — 2.6964

497 lbs.

No. 7 3134.8 feet per Ohm

.00 3254 — 3.5125 — 2.4875

307 lbs to Ohm

No. 5 Wire

220 / .14 / 284

72 · .1234

307 turns

491 feet

6125 : 63

334 / 259 — 3.8034

6125 — 3.7871

100 — 2.0163

Glasgow to an Ohm about

5-11

5-30

5-50

5-71

592

614

3859

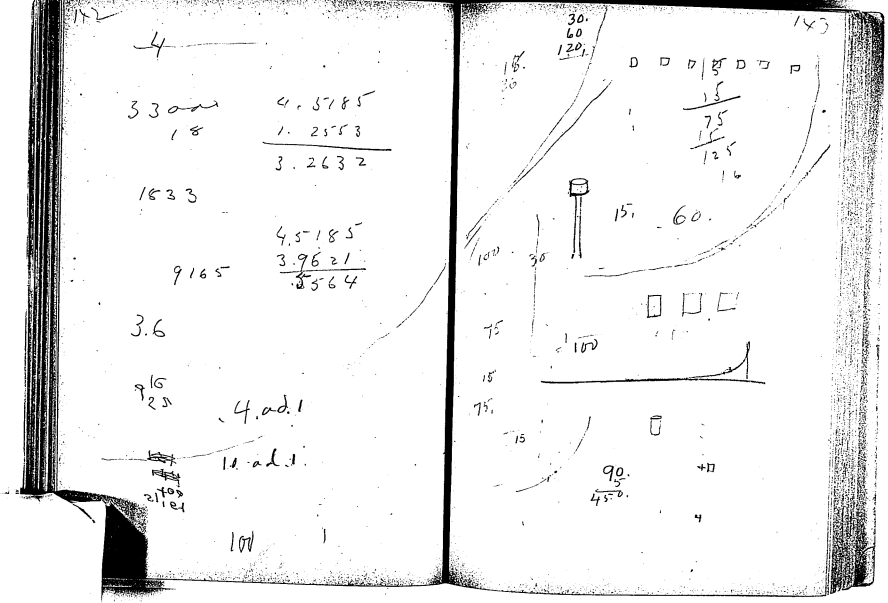
637

4496

1.85773
7.36792
2.48881
2.69274
.0163

307
5
2454

2.7888
.0163
2.7725
.0163
2.77087
.0163
2.78750
.0163
2.80413



Magnet

1 ohm

No. 10 wire

100 1.5

816 | 204 | 612

816

500 7.5 | 204 | 408

.48
365
1752
1752.
919
730.2
1919
2297
6893
4 | 1355.2
1836
5514

7.6812
2.562 3
2.243 5

7.68224
2.56327
2.24353
1.8833
1752
485
1347
878
478
399
557

2 cents on hmm

24

.48 cents a day

365 days.

$175.2

$43.79

$1752

$438

1314

438

876

876

219

657

219

438

1.6812

2.5623

2.2435

log 40 .6021

1.6414

log 4 .0602

1.0393

70

19

2.2435

.3802

1.8633

24

1919

229.7

5893

2293

1600

1.8633

1.9633

Ans!

365

2

730

730

36.5

18.25

5475

2.2435

.3802

1.8633

1 540

15 total 540

36 apiece

they will equivalent to

1080 candles

15 of

7½ of 15 37.0

7½ of 36 135 candles

36

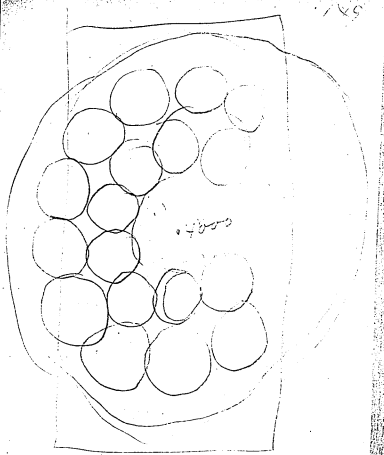
$15^2 : 6^2 :: $:

36 1,55·63

36 1,55·63

1761 3·11·26

35 22 2·35·22



15 : 4000 :: 3^2 : x^2

4

36000

15

4.5563

1.1761

3.3802

1.6901

49 feet

15

7 feet long

7 | 100

14

3

45

45 Gasburners

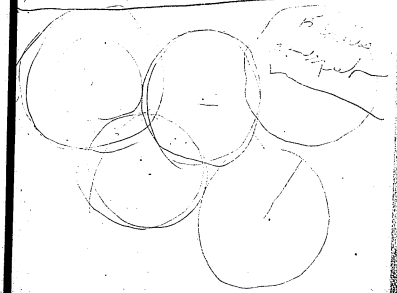
15

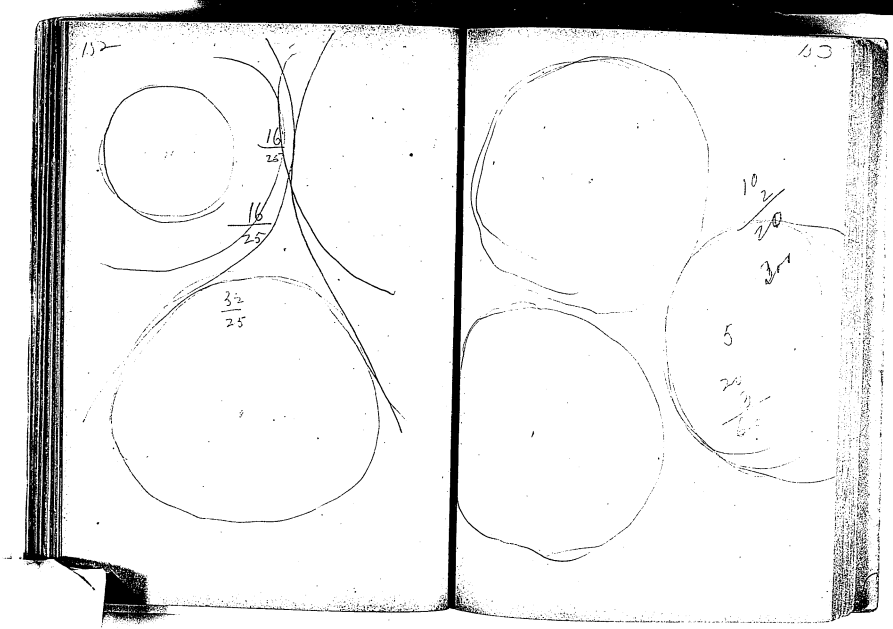
225

45

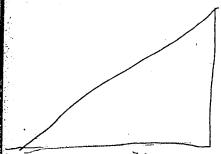
675

675 Candles as good as a 4000 Candle power if the ~~light is~~ [illegible] ~~stronger~~ light is needed than a gas burner at [illegible] feet




112
16/25
16/25
32/25
10
2
20
5

15 Candles in circle of 75 feet radius and 30 feet above the floor



1.8751
1.8751
3.7502

900
562.5
6525

log 3.8145
1.9072

80.7 feet

6525 — 3.8145
16 — 1.2041
4075 — 2.6104
4000 — 3.6021
2.6104
.9917

9.82 Candles at four feet away

five feet circle

6525 — 3.8145
25 — 1.3979
2.6166
3.6021
2.4166
1.1855

15.3 Candles

150

$\frac{75}{6}$

69 7

5

80.7	1.9072
11.	1.041v
	.8668

80.7
7.359

72.35

3141	1.8591
	.4969
	2.3560
227	.8668
	1.4892

2 | 30.8
15.4 amps

11 [illegible]

15

$b_1 = 1360$

$a_1 = 1010$

$b_2 = 2960$

$a_2 = 950$

158

7.36
2
14.72

72,35
14.72
57.63
14.72
3.14

1.7604
8.8327
.4969
1.0700

12.4

57.63
1472
42.91

1.6325
8.8327
4969
10.9721

9.36

9.1296

42,91
1472
2819
1472
47
14.72

1.4502
9,12..
.5798

1..1673
9,12..
2..6.

194

30.8
24.8
18.8
7.6
1.9
11
85.7
15
1280

1.9532
1.176
3.1291

Carlisle & Finch
the pioneer of Morse candle
power

In a space 150 across having a 4000 candle light 30 feet above the floor it would take

$5 [illegible]

Total 1280 candles

Total 1280 candles
1280
12

3 times more effective

4000 — 3.6021
1280 — 3.1072

3.12 — .4949

3.12 more effective

Room 100 long 23 ft.

4000 candle power

50

3 feet

2500

2500 : 7 : : 100 : 14

25 × 60000 (illegible)

25
110

1/

5.5.

100 4

12

162

Suppose 75 feet

30 feet above

that 80.7 see p. 157.

$9\overline{)80.7}$

8.94

80.7 × 8.94 = 721.76

5150

$\sqrt{.86556}$ = .93035

3.7116

$\sqrt{5150 : 8.94^2 :: 2000}$

.9513

.9513

1.9026

3.4771

5.3797

3.7116

2.6681

46.

5150 · 3.7116

163

5150 : 5^2 :: 4000 :

Eng 2 5

1.3979

1.3979

3.6812

4 rows

6.3979

3.7116

1.4

1.3979

3.6812

5.3791

3.7116

1.6675

(6) 75^2

1.875

1.875

3.5156

1.3979

5.5135

3.7116

1.4019

26.7

60

$75^2 : 5^2 :: 4000 :$

1.1875-1	6.2498 − 10
1.8751	1.3979
3.7502	3.6021
	1.2398

17. Candles

$75^2 ; 4.5^2 :: 4000$

6.2498
3.6021
.6532
.6532
1.1583

9.8319 − 10

14.4 Candles

4.7

9.8519 − 10
.6721
.6721
1.1961

15.7 Candles.

[illegible] at a [illegible] distance 4.6 feet will give as much illumination as a 4000 candle power light at distance of

---

$75^2 ; X^2 :: 4000 :$

~~6.2498~~
3.7502
6.3978
1.1761

9.8519 − 10
1.1761
1.6758
1.8140

X = 241 − 10
1.6620

1.6 feet

166

Arrow

$\frac{25}{46^2} + \frac{25}{46^2}$

.16628
.16628
1.33256

$4.6^2 = 21$

$\frac{1}{21}$ = intensity light 4.6

$\frac{1}{25} + \frac{1}{25} = \frac{2}{25}$

$\frac{1}{36} + \frac{1}{36} = \frac{1}{18}$ intensity at 6 feet

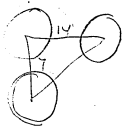
$\frac{1}{49} + \frac{1}{49} + \frac{11}{245} =$

$\frac{1}{49} + \frac{1}{49} + \frac{1}{61}$?

$= \frac{3}{49}$ of other light
Taken into consideration

$= \frac{1}{18}$

167



14
14
56
14
196
49
245

2.3892
1.546

15.6

7.2 feet will be the radius of the light

14.4 = Diameter

14.4)75 (5
14.4
.21

.5751
1.1584
.7167

14.4
5
720
3

168

7.2

75
7.2
678
2
135.6

3.14

comp. 14.4

~~329~~
30.4

2.1320
~~.5514~~
.4969
~~8.8539~~
~~1.8173~~
1.4828

169

$75^2 / x^2 :: 3000 : 15$

1.8751
1.8751
3.7502
1.1761
~~4.~~9263
3.4771
1.4492
.7246

$\frac{1}{28}$ = intensity

$\frac{1}{49} + \frac{1}{49}$ =

$\frac{1}{64} + \frac{1}{64} + \frac{1}{32}$

that $\frac{3}{81} = \frac{1}{27}$

9 feet Radius

75 / 9 / 66 / 132

18 / 2 / 36

3.14 Group 18

2.1206 / .4969 / 8.7447 / 1.3622

9.2416 − 10

23

132 / 36 / 96

16.7

9.2416 / 1.9823 / 1.2239

96 / 36 / 60

10.4

9.2416 / 1.7782 / 1.6198

60 / 36 / 24

9.2416 / 1.3802 / .6218

1 / 4.18 / 10.4 / 16.7 / 23 / 53.28 Comp.

15

1.7424 / 1.1761 / 2.9185

829 Candles

3 sec

829

3.1771 / 2.9185

3.62 .5586

3.62 more effective

2000 candles

The space to be illuminated is taken as 72 feet distant from the light. The light the same as before 30 feet above and having a circle of 60 feet radius to illuminate.

$12^2 : x^2 :: 2000 : 15^-$

1.8573
1.8573
1.1761
Cy 15 — 1.1761
2000 — 6.6990 — 10

2 | 1.5897
98.9 — .7948

= 6.23 feet

38.9 — 1.5897
3 — .477
116.7 — 2 | 2.0668
10.8 feet — .0334

15
10.8
64.2 — 1.8075
2 — .3010
9.14 — .4770
Comp 21.6 — 1.6635
18.6 — 1.2710 — .4635

64.2 — .8075
21.6 — .3345
42.6 — .4730
12.4

144

42.6
21.6
210

6.11

9.4635
1.3222
.7857

2.
6.1
12.4
18.6
39.1
15

1.5922
1.1761
2.7583

573

2000
573

3.3010
2.7583
.5427

3.49 times more effective
than in gas burner

1000 candle power

The strength at 65 feet distant
from the light

$65^2 : x^2 :: 1000 : 15$

1.8129
1.8129
1.1761
1.7019
.8509

50.3
7.1

50.3
3
50.9

2.1727
1.5563

12.2 feet

75.
12.2
628

1.7482
3.3010
.4472

3.1
24.4
16.1

8.6726
1.2386

9.4006

176

6.2.8
24.4
3.8.4

9.4006
1.3843
.9849

9.6

38.4
24.4
14.0

9.4006
1.1461
.5467

3.52
9.6
16.1
29.2
15
438

1.4654
1.1761
2.6415

1000
438

3
2.6415
.3585

2.28 times better.

177

In this case very much of the area is better lighted since that part which is near the

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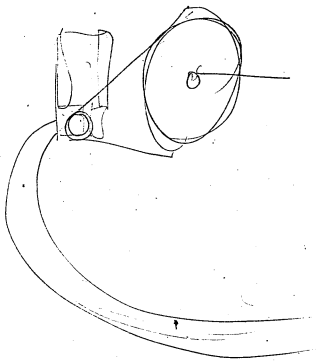
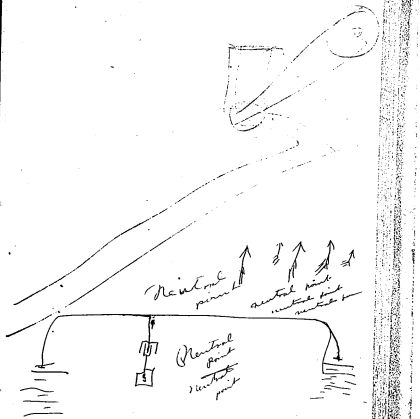
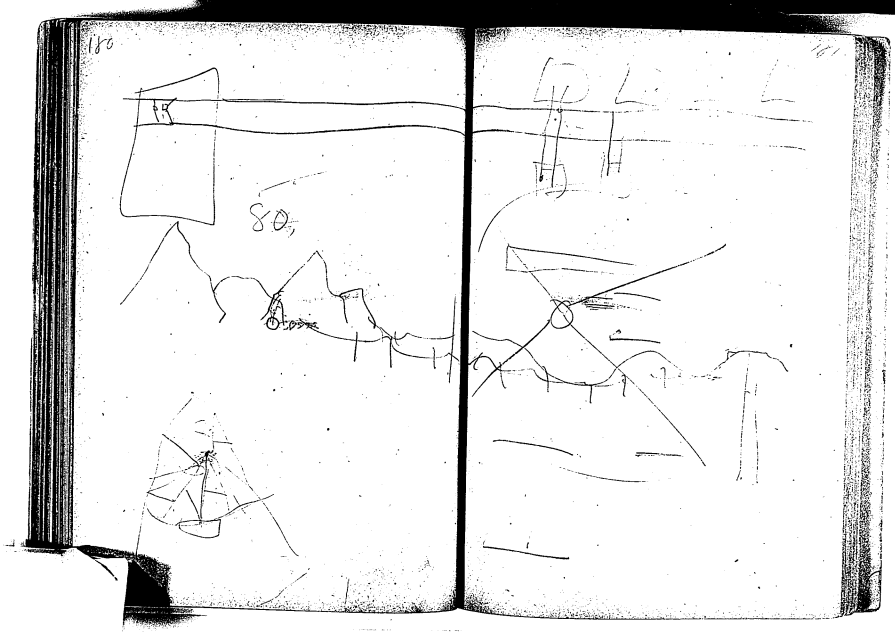
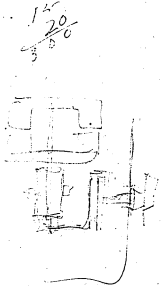



Neutral point
Neutral point without pick


180
SO,
Ocean



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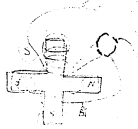
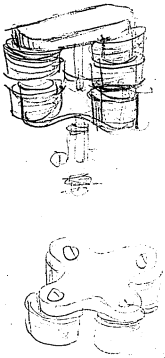


Gou

George E Gowdier Governor

Constitution

Rondout Constitution



100
1 1.5

Comp 101.5
log 100

98.4
96.8

Comp 51.5
log 50

971
94.3

3 33.3
1.5
34.83
33.33

956
25 914
1.5
26.5
25

946
895

8.9935
2
9730
1.9860

8.2882
1.6990
9872
9714

8.4581
1.5224
9805
9610

8.5728
1.4031
9759
9518

20
1.5
22.5
20

93
86.5

15.66
15
10.16
15.66

917
84.1

14.28
1.5
15.78
14.28

905
81.9

12.5
1.5
14.0
12.5

893
79.7

8.6678
1.3010
4776
4686
9372

8.7409
1.2218
9627
9258

8.8019
1.1547
9566
9132

8.8539
1.0969
9508
9116

9
11.11
1.5
1261
11111
8.8993
1.0457
1.9450
8900
881
77.6

10
10
1.5
11.5
10.00
8.9392
1.
9392
8784
869
75.6

11
9.09
1.5
10.59
9.09
8.9751
1.9585
9236
8672
858
73.1

12
8.333
1.5
9.833
8.333
9.0073
1.9206
9279
8558
847
71.7

13
7.692
1.5
9.192
9.692
0.366
1.8859
.9225
8950
836
70

14
7.14
1.5
8.64
7.14
9. 0634
8537
9171
8342
82.6
68.3

15
8.66
1.5
9.16
6.66
9.0884
8234
9118
8236
81.6
66.6

16
6.25
1.25
7.75
6.25
9.1107
.7958
1.955
8130
80.6
65

17 5.882 1.5 7.382

18 5.555 1.5 7.055 9.1515 7462 .8957 78.4 5 61.9 7914

20 1.15 6.15 51 9.1871 6989 .8860 76.9 59.2 7720

25 4 1.15 5.15 4 9.2695 6020 .8715 74.5 55.3 7430

30 3.33 1.5 4.83 8.37 69. 9.3161 .5225 .8889 47.6 6778

100 1.5 20 3 600

171 1965 5 9825 1923 5 9615

1881 5 9405 1849 5 9245

1814 5 9070 1714 5 8570

1653 5 8265

1591 × 5 = 7955

1486 × 5 = 7430

1389 × 5 = 6945

1280 × 5 = 6400

1150 × 5 = 5750

1922 × 5 = 9610

1849 × 5 = 9245

1714 × 5 = 8570

1653 × 5 = 8265

1486 × 5 = 7430

1389 × 5 = 6945

1135 × 5 = 5675

95.2 + 95.2 = 90.6

9786 + 9786 = 19572

1020 × 5 = 5100

888 × 5 = 4440

2.1576
2.1576
.4971
4.8123
.6020

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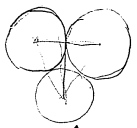


500 candles

@ $6.0^2 : x^2 :: 500 : 15$

1.7782
1.7782
1.1761
Comp 500 7.3010 − 10
2 | 20335
108 1.0167
10.3 feet

324 | 2,51105
18.2 1.2352

35 feet

50 1.6990
31 0.4914
.3010
Comp 2.5 8.6031
1.0995

12.5 .3979
7.25

.28

7.25

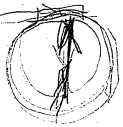
15 1.1761
2.0542

1.29

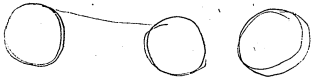
500 2.6990
199 2.0782
.6208

4.5 times water

191 72



Dynamo machine
Dynamo machine
Dynamo machine
Dynamo machine



199

80 220 135 = 1
42 : 0
57 : 1

12 75 feet wire

cost of wire?

1.6 = 1
7 = 1
T. 2 : 1

Gas 1 cent an hour
2 hours a day
T. 4 11
T. 4 : 1

2 cents
365
730 $ 3 73

$ 73 capital to pay for
a gas jet an hour
a day

365
2
730

1752

1752 3.2430
24 .3842
2.8628

729

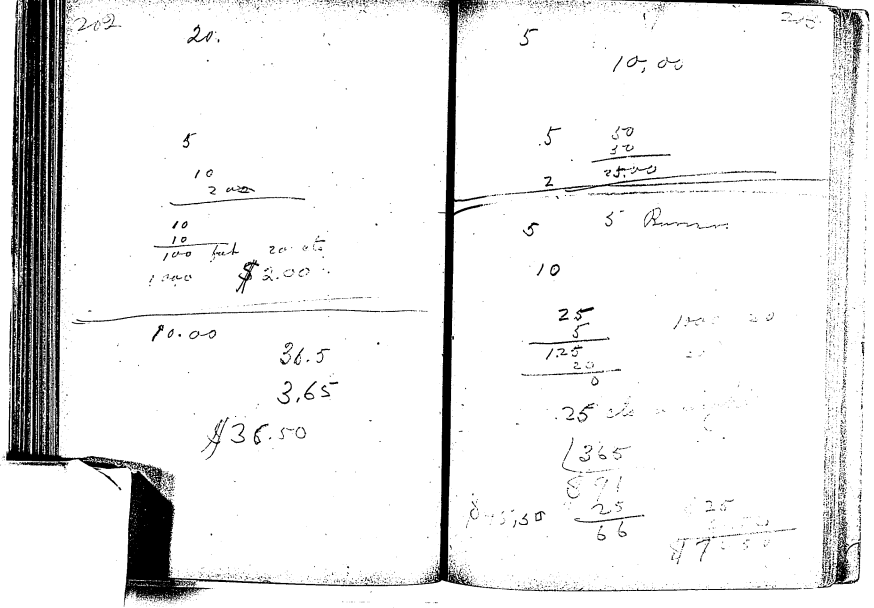
365
2
730

¥73.00

5

1

36.50

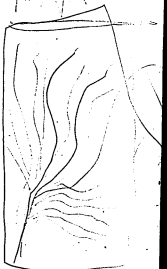


$450
$4.50
$45.00

5000
1
800

365

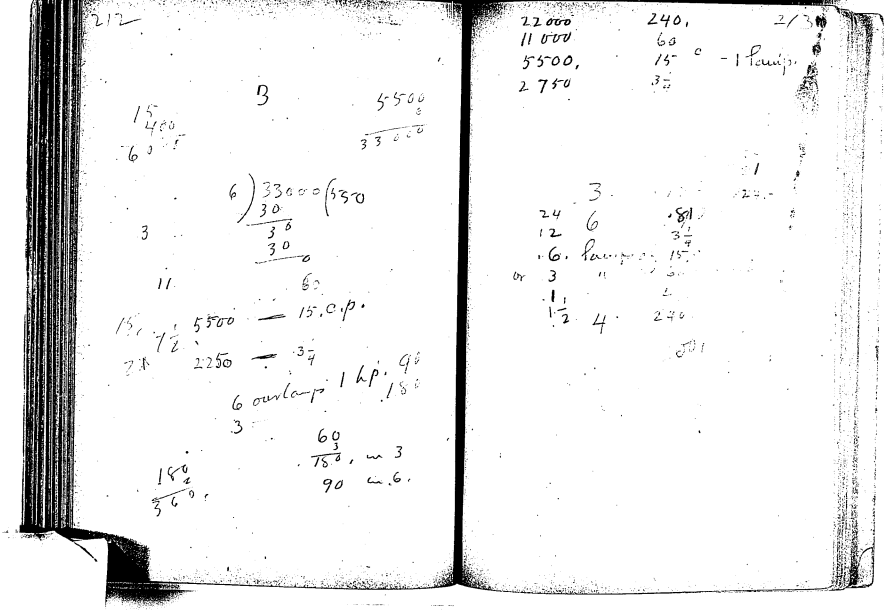
100 Ohms
.02 Ohm
5000



206

40

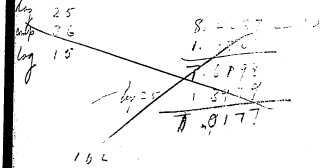
5 ℓ 80.



176.9
2041
1.9720
3802
.3522

225

9
9)115
375
9
32 75
4 4
128



log 86
log 15
25
21.6
108.

1.5563
1.1761
2.7324
1.3424
1.3900
1.1430
3.0330

7

49

110

77

2.7324

1.6902

1.0422

8

64

84.4

68.52

2.7324

1.8062

0.9262

9

81

6.66

59.94

2.7324

.9085

.8239

10

54

54

2.7324

.7324

11

121

4.46

446

49.06

2.7324

2.6828

.0496

12

1139

1139

3.2278

3.19

41.55

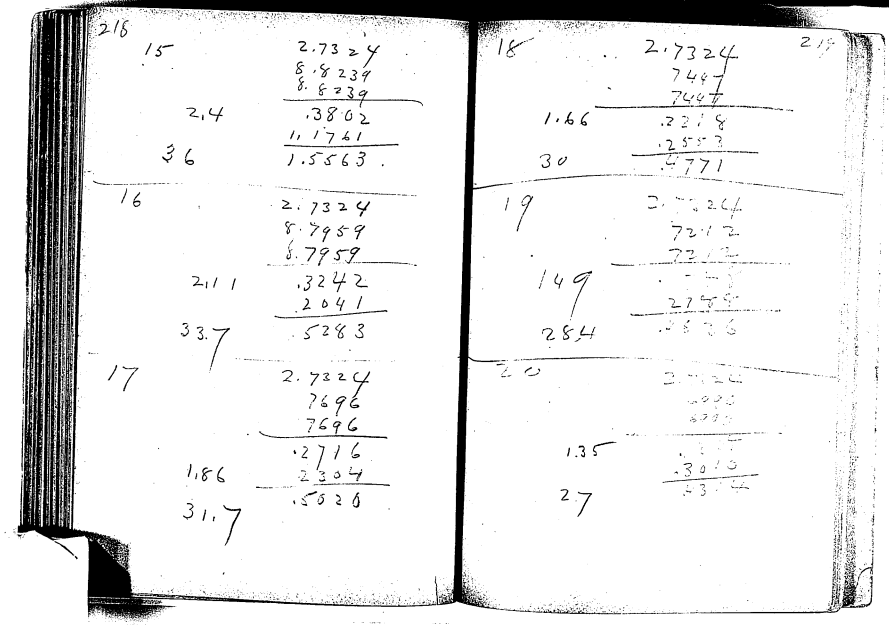
13

1461

2.75

38.5

14


218

15

2.7324
8.8239
8.8239

2.4 .3802

1.1741

36 1.5563

16

2.7324
8.7959
8.7959

2.11 .3242
.2041

33.7 .5283

17

2.7324
.7696
.7696

1.86 .2716
.2304

31.7 .5020

18

2.7324
.7447
.7447

1.66 .2318
.2553

30 .4771

19

2.7324
.7212
.7212

149 .2788

284 .5000

20

1.35 .2701
.2299

27 .4599

21

21

2.7324
.6778
6778
1.22 .0880
3222
25.7 .4102

22

2.7324
6576
6576
1.11 .0476
3424
24.6 .3906

23

2.7324
6383
6383
~~4295~~
10.2 .0090
3617
23.4 .3707

1 light 540 candles

15 lights

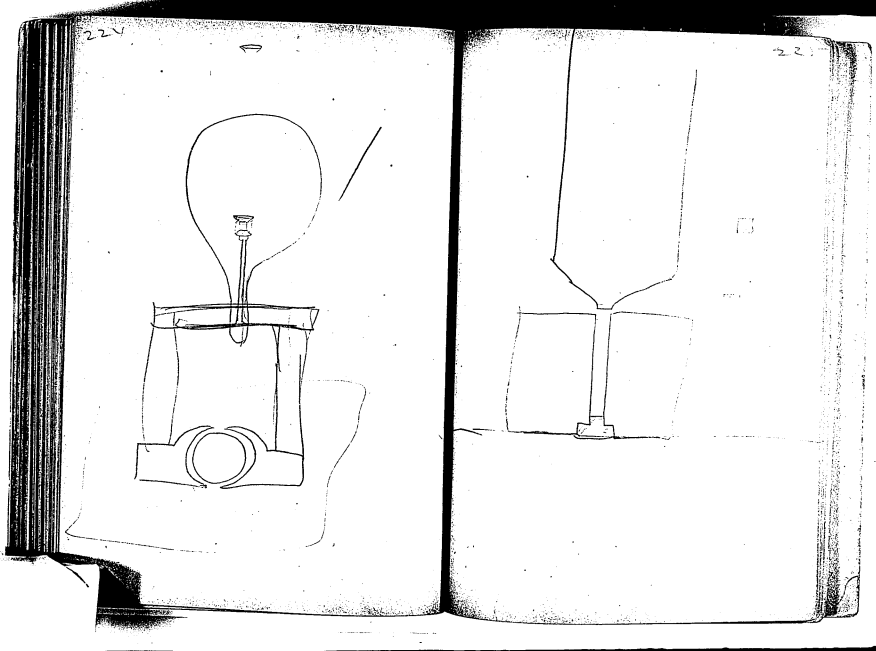
15 lights 36 candles each
= 540
but equivalent to 1080 candles

15 lights 18 candles
= 270 candles
equivalent to 540

15
15 225 lights 12 candles
225 each = 270

15 lights 12 candles 540

225 of 16 yards each 30 2



228

10%

200

10 | 2.3010
1.

1/10

110 | 110
100

2.3010
2.0414
.2596

18.1 years

22

1.10 | 1.0
1.10 | 1.10
1.10 | 1.10
1.10 | 1.10
1.10 | 1.10
1.10 | 2

log 2. .3010
.0414

.0414
.0414
.0414

7% 10 years

.0414) 3010 (7.2 years
2898
1120

294) 3010 (10.
294
0700

7% 10 years

0212) 3010 (14 years
212
890
848
420

0212) 3010 (
14 years
14 years
14 years

10 o'clock
5 o'clock
14 years to have double
14 years to have double
14 years to have double
14 year to have double
14 years to have double

How do you get that now
How do you get that now
How do you get that now
Magnet 7 years 7 years 7 years
7 years 7 years 7 years 7 years 7 years
7 years 7 years 7 years 7 years 7 years 7 years
7 years 7 years 7 years 7 years 7 years 7 years
7 years 7 years
14 years

253) 3010 (11.8 years
253
480
253
2270

1.06
1.06
636) 1000 (26
1.06
1,1236

11.8
378
11.8
496
11.8
614

26 5000
7
35 10000
7
42 20000
7
49 40000
7
56 80000
63 160.000

6 5000 2 5000
4000 2 5000
2000 10000
4000 20000
8000 40000

How long will it run.

$4000

$4000

$100.000

$100.000

$100.

234.

12 3 coat long

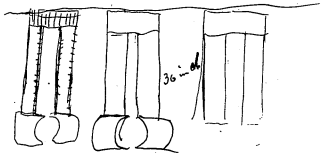
6 1/8 in. diameter

6.125 in

18 machines from one

3 are 6 ohms each

or 6 ares 12 ohms



Both magnets

72 in long

6.125 0.7871

3.141 .4970

1.2841

12 1.0792

2049

1.6 feet

1.6 feet

½ ohm ½ ohm ½ ohm ½ ohm ½ ohm ½ ohm

½ ohm ½ ohm ½ ohm ½ ohm ½ ohm ½ ohm

½ ohm ½ ohm ½ ohm ½ ohm ½ ohm ½ ohm

½ ohm ½ ohm ½ ohm ½ ohm

No 10 wire

.134 in D

14 coats

.148 in

lay 72 1.8573

coat .148 10.8297 -10

2.6870

497.8 turns in 2 layers

995.6 2.9978

1.6 .2049

3.2027

159.3 feet

1595 feet on magnet
1737 feet per Ohm

1595 — 3.2027
1737 — 3.2398
1.9629

.918 Ohms

16.44 feet to lb.

1595 — 3.2027
16.44 — 1.2658
1.9369

86.4 lbs. — 1.6021
.40 cts to lb. — 1.5390

$34.50 cost
$32.50 5

½ H.P.
½ H.P.
½ H.P.
½ H.P.

Make the same no. of turns and have the resistance ½ Ohm
That is use two strands of No. 10 wire
Cost $69.00

If the machine is to head with low outside resistance this is the way to wind it

If the machine is used ten hours a day on 6 and the magnet consume in the first case
1 H.P. by this can be saved
½ H.P at 2 cents
73 — $365 can be effected
5
365

This supposes that the machines is used on a resistance of 4 Ohms uses 4 H.P on 6 H.P to an Ohm

100 Volts

100 Volts

6 1 Ohms

1 36 Ohms

---

6 Ohms

$6 = 6$

$1 \times 6 = 6$

$\frac{36}{6} \times 6 = \frac{1}{6}$

---

36 Ohms

240

No. 13 wire

.095 = N
.012
.107 = D

72. 1.8573
Comp .107 10.9706 -10
2.8279 -10
.2041
3.0320

673 times
1.6 feet
1074 feet

873 feet to Ohm

873 1.5563
2.9410
4.4973
3.0320
1.4653

29.2 Layers

25 Layer

673 times
16825 times

if 40 layers 500).2704
42
5.40

5.4 times stronger

679 5 Layers

5

36 Ohm 1.5563
873 feet to Ohm 2.9410
4.4973
3.0320
29.2 Layers 1.4653

.0419 1.3778
36 1.5563
2.9341
1859 lbs 1.1021
40 2.5362
$343

241

242

No. 20 wire

36 ohms

.1035
.041

72 1.8573
.041 11.3872
3.2445

1755 turns
1.6 feet
2820

.2049
3.4494

118.5 2.0738
36 1.5563
3.6301
3.4494
.1807
3.2445
3.4252

1581

2660 turns

No. 10 wire

995 turns

2660 3.4252
995 2.9978
.4274

267

3.4494
.1807

Do not throw away my wheel

1/6 current

36 1.5563
2.27 0.3560
1.2003

15.9 lbs

Extract 1/2 an atom

243

If magnet shunt 3 times E. M. F.

No. 19 wire

.42 / 5 / .47 — .047 — 33

72 1.8573
10.3279
~~1.5294~~
3.1852
~~1535~~
1535 turns
.2049
3.3901

1 Ohm

Gramme machine for example in a carbon light 1/2 Ohm in ring
1/2 Ohm in magnet
1 Ohm in lamp

E. M. F 75 Volts

E. M. F. 75 Volts

1 H. P. required

1/4 75.

18.75 Webers

18.75 — 1.2728
18.75 — 1.2728
4 — .6021
44.5 — 1.6484
4.7961

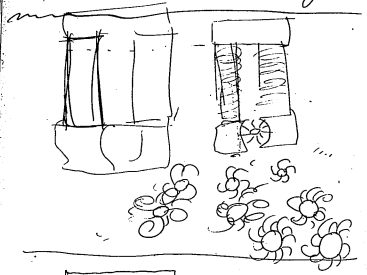
61,700 ~~ft~~ lb

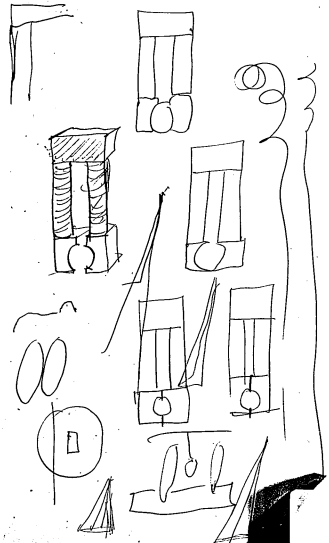
4.7961
33000 — 4.5181
.2780

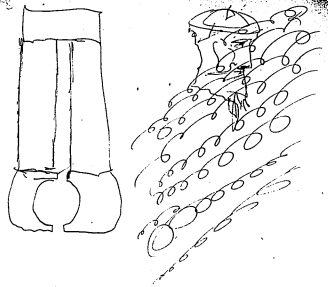
1.9 H. P.

246

1/2 H.P. on magnet







½ H.P. ○ ○ ○ ⊗

½ H.P. ½ H.P. ½ H.P.

½ H.P. ½ H.P.

To render the instrument less 4 watt proof

How machine wound ½ ohm in circuit what will be the resistance in shunt to consume the same amount of energy

E.M.F. = 4

Current = 1

R = 1 Work = 1

E.M.F. = $\frac{2}{3} \times 4 = \frac{8}{3}$

$\frac{64}{9} = R$

$\frac{9}{64} = c^2$

$c^2 R = 1$

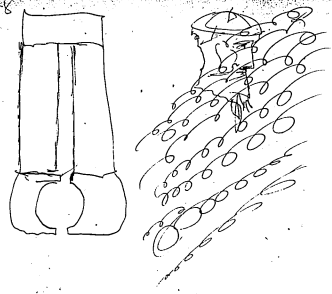
$\frac{64}{9} = 7.111$ ohms before

$\frac{8}{3} \times \frac{8}{8}$

$\frac{64}{9}$

$\frac{3}{8} = C$

$\frac{3}{8} = .711$



½ H.P. ○○ R

½ H.P. ½ H.P. ½ H.P.

½ H.P. ½ H.P.

1

To render the instrument less
[illegible] to [illegible]

Now machine wound ½ ohm
in circuit what will be
the resistance in shunt to assume
the same amount of energy

E.M.F = 4

Current = 1

R = 1 Work = 1

E.M.F. = $\frac{2}{3} \times 4 = \frac{8}{3}$

$\frac{64}{9} = R$

$\frac{8}{3} \times \frac{9}{64}$

64

$\frac{64}{9}$

$\frac{3}{8} = C$

$\frac{9}{64} = C^2$

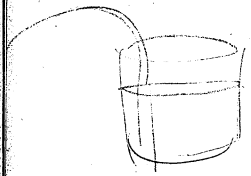
$\frac{3}{8}$ .711

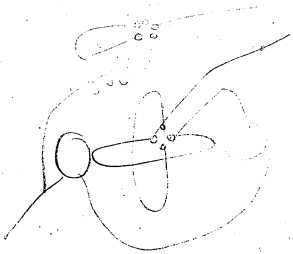
$C^2 R = 1$

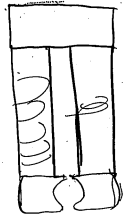
$\frac{64}{9} = 7.111$ ohms before

Siemens — 70-
Gramme — 5-5-
Wallace 13
Edison 88@90-

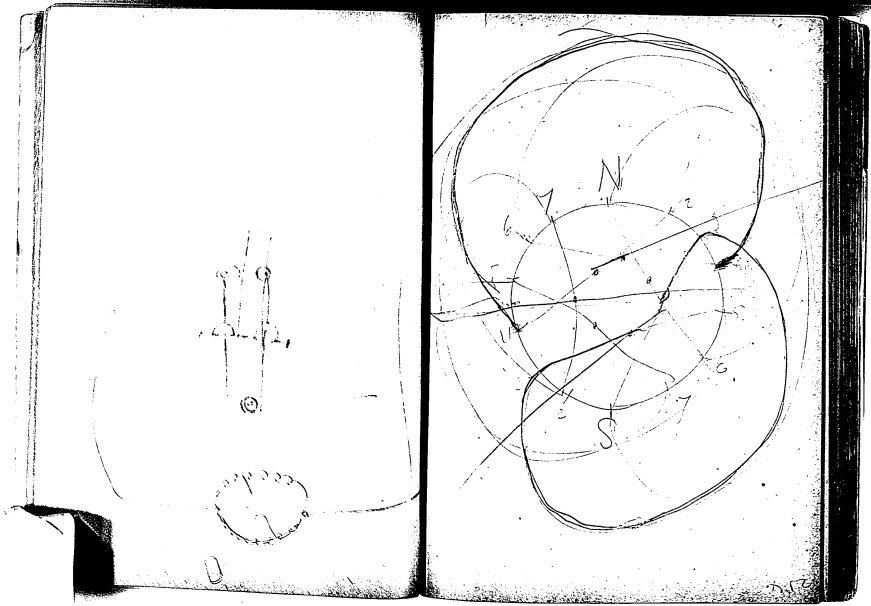
40.
55







How do you get time now?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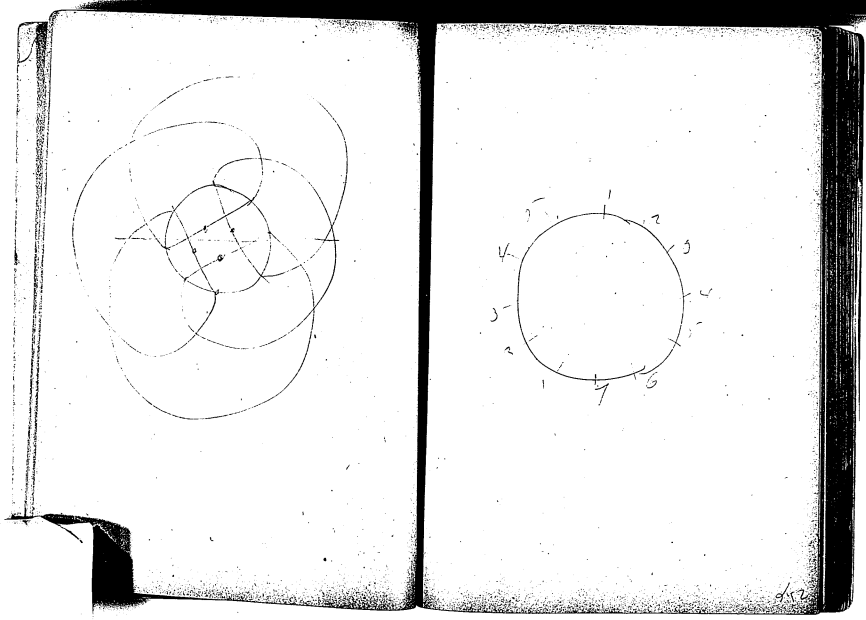
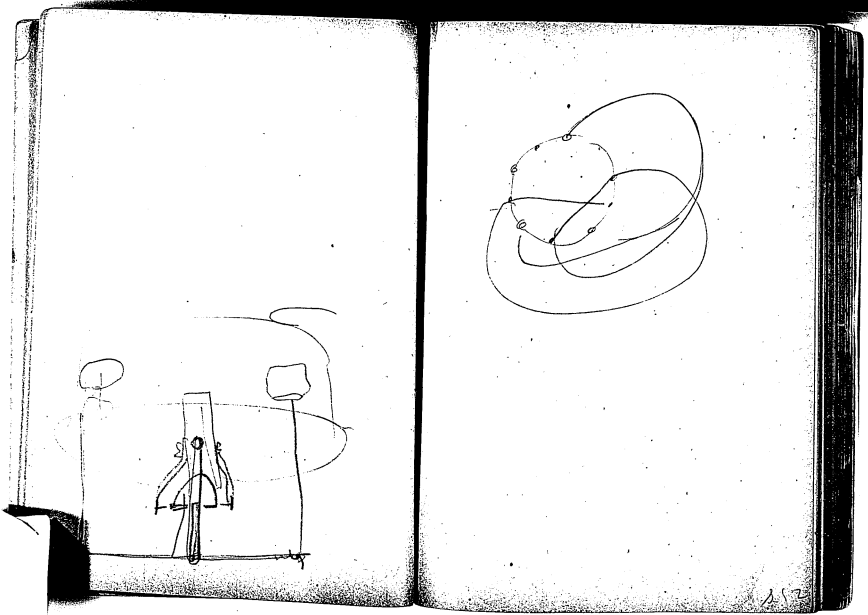




Daniel cell having 2 ohm internal and 2 daniels have ¼ ohm internal + 10 ohms outside ~~make it equal~~ for about same deflection makes it equal to a little more than 4 Daniells

Machine works very strong 700 ohms. (Coat is all !!!

Resistance of [illegible]

.46

Armature .31

.77 Ans

Use of Small Apparatus on Tangent Galvanometer —

Gun Cel on Short Circt. $3\frac{1}{4}°$
" " on 10 ohms

Machine on short circt. with 1 carbon on Field —

~~revolutions~~

231	revolutions	11°
396	"	19°
429	"	21
616	"	26
1221	"	33
1321	"	32

On 10 ohms resistance

561	revolution	1° 45′
924	"	2° 30′
1232	"	2° 45′
2012	"	1

28

56
56
616

26°

37
3
111
111
1221

33°

40
3
120
120
1320

32°

10° Ohms outside

17
3
51
51
561

1° 45'

28
3
84
84
924

2° 30'

28
4
112
112
1232

2° 45'

33
3
99
99
2012

10

192

36
36
396

1 cell Carbon

Commutator set one block ahead 396 Revolutions

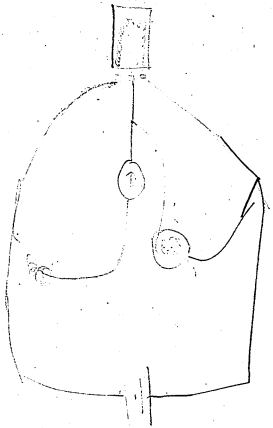
18° to 20°

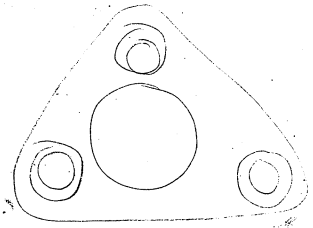
21
21
231 revolutions

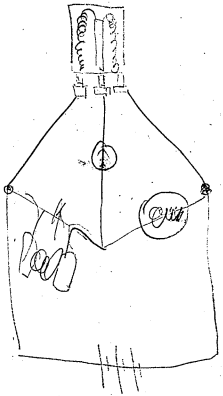
10° to 12°

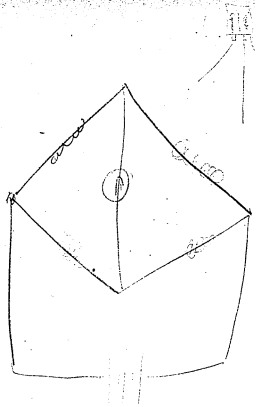
39
39
429 revolut

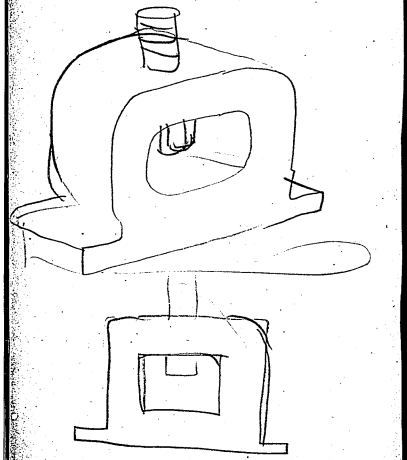
20° 22°

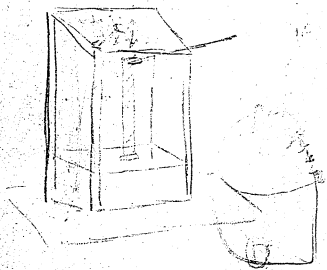












950

1000

Menlo Park Notebook #34 [N-79-03-25]

This notebook covers the period March-June 1879. Most of the entries are by Edison and Charles Batchelor. There are also entries by Francis Upton and John Kruesi. All of the material relates to either electric lighting or the telephone. The electric light material includes notes on coatings for metal filaments; drawings of lamps; notes, drawings, and calculations about generators; and drawings and calculations about electric power distribution. The telephone material includes notes, drawings, and tests of the electromotograph receiver; notes and drawings of a central telephone exchange system; and notes on parts and prices of telephones. The book contains 284 numbered pages.

Blank pages not filmed: 110-111, 146-147, 152-153, 170-189, 206-207, 210-217, 220-225, 252-281.

No 34

LIBRARY OF THE

BOARD OF PATENT CONTROL.

120 BROADWAY, NEW YORK.

March 25 1879—

Chas Batchelor

Pyro-Insulation for Platinum wire

1 Nitrate of Barium put on the finger and the wire rubbed through it a very little sticks to the platinum but not enough to make good insulation

2 acetate of Magnesia makes very good coating but we want it thicker than ~~this~~ we get this and easier to put on. The acetate feels a little soapy and sticks well to the platinum. It is very pliable even with a coating of .003 on a .005 wire

3 Nitrate of Magnesia goes on very easily but very rough and when wound on spool it seems

March 26' 1919 Page 3

Chas Batchelor

to break off on top side showing the platinum underneath entirely free from coating. Thus it is a platina wire with a loose coating on. We got this on as thick that a .005 wire coated measured .010 this when wound on spool and heated in vacuum gave the best light we have had from our small experimental lamps.

---

4 Tungstate of Soda.

Is difficult to get on and only hardens in globules on the wire which cannot be easily taken off without drawing them off the end of the wire, what does get on the wire is almost transparent

---

No 3

When heated to incandescence it was the best we have had of this size (about 8 candles) afterwards Edison busted it and under the microscope it looked as if it had been torn

Mch 26th 1879

5 Acetate of Lime - Charbatchelor

This coats the wire very beautifully and exceedingly fine; but the lime seems to combine with the Platina the coating is so fine that 100 coatings would not make a .005 wire more than .00575 thick.

6 Nitrate of Lime is a very fair one but too lumpy and takes too long to put on smooth; as in taking off the lumps it removes the rest. Made no spool of this as yet

7 Nitrate of Magnesia + Acetate of Magnesia

This makes good and thick coating the acetate making it stick to the Platina and the Nitrate thickening it. We made a spool of this and

Asunder and in some parts globular and in others it appeared to have volatilized and left the core spongy. Some parts showed Iridescence

7 will try it; when on the spool it shows no cracks and coats very thick at .010

8 Chloride of Calcium
No good. burns on hard and very irregular and moreover attacks the Platina

9 Aluminic Nitrate (Sat.) with a little free Acetate in
goes on pretty thick but cracks a little when wound. This could be easily overcome by allowing them to be wound damp and when heated first time in a vacuum it would dry in its place. .005 wire covered with this easily comes up to .010

March 26 1849
Chas Batchelor

Chas Batchelder

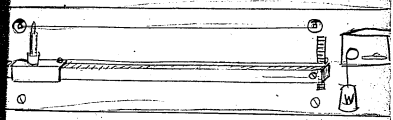
10 Acetate of Zinc

not good. when on it feels like soapstone and comes off with slightest touch

Nitrate of Aluminum No 9.

when heated and after heating in vacuum looks under the microscope as if the wire had expanded and the covering had not and the wire had broken the covering so that it seemed to be made up of bone ferrules about equal length

Covering Wire (Machine) April 1st 1849 Chas Batchelor



- Candle carriage adjusts up and down to suit the flame
- Candle drawn by clockwork (for copying) by friction so that when ~~down the~~ it has gone once over it can be pulled back.
- Must be made on bracket & screw on edge of a shelf or table

Chas Batchelor

Chas Batchelor

April 1st 1879

Chas Batchelor

In our experiments with the small spools we find when we fuse them they always give out at the bottom

May be due to point of greatest potential

9 pm

Make a spiral of .020 thickness

Platinum
Copper
Aluminium
Steel
Iron
Chem. pure Iron Made

for Glass-
Blower to seal
in bulbs

Made
3 of Platinum
3 of Pure Iron ordered drawn
3 of Drawn wire ordd
3 of Copper
3 of Aluminum
3 of Magnesium
4 of Nickel ordd.

April 1879

Make specials for Vacuum
4 10/ Iron Platinum

4 '010 Pt Ind. 10/
4 '010 Pt. Ir 24/
4 '010 Pt Ir 20/ with Mag
4 '005 Pt Ir 20/.
4 '005 Pt Ir 25/ Not Mag

Make-
2 Lime cylinders 2 layers

'005 Pt. Ir. 24/
+ Insulation '012
brought up in hand pump
first.

April 1899

Make 2 Instruments for testing spools, glass tube made out of battery bottles

Make platinum silver ~~on~~ corrugated diaphragm & hood built [illegible]

Take 1 Anschütz instrument [illegible]

D. Apatite
Tur
Oct 6 '79

Sand mixed with 40 parts of Tur to 100.

Covering and all. 013 when wound on the spool this breaks all up so that you can see the features —

Think I made (3 pcs) to mix Nitrate of Magnesia and Sodium Picrate & Glycerine strike in water & stir with iron and cook so that it would hold the nitrate covering together

April 4 1879

12 Noon Put the leaves used in bottle containing Chloride of Calcium solution and connected them to the cell of Daniels battery to see whether it would react on its neutral

12 Noon Put Lead Chromium in boiling Sulphuric Hydrogen to see if it would dissolve

April 7 1849

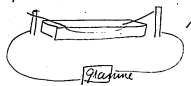
12 noon Put a piece of platina wire in Chloride Magnesium with battery in to see if it would oxidize on it

T A S

April 4th 1911

Coating Platinum Wires

Try.



Acetate Mag Solution
Keep wire hot with
Gramme mael

Try Coating the ~~&~~ Tow covering of Acetate of Magnesia with rubber dissolved in Benzine to make pliable in winding

April 7. 1899

Platinum Impoverishment

Deposit from Chl calcium or Chl Magnesia by battery

Chloride Mag. Solution on Gramme machine with about 60 ohms resist. deposit very thick on one wire, looks crystalline in form full of cracks — when dried it cracks by contraction so that it leaves large spaces in between

Chl Calcium work better apparently from Coating dont crack but when bent + rubbed comes off completely perhaps a coating of rubber would do this good

Apl 7 1879

Platinum Pyrosimulation

Try amalgam of Mg. and Hg
Volatilizing Hg with Heat

Try rubbing metallic Ba & Mg
on wire

Apl 4 1899

Suspend wire in boiling Carbonate of Magnesia or any salt of Mg. and see if it becomes coated internally

Make a piece $\frac{9}{1000}$ thick straight and bring to incandescence and see if it cracks when winding on a $\frac{1}{8}$ mandril

OK. this is the best yet ~~Spoke~~ bringing to incandescence ~~and~~ causes it so that it looks solid and hard and crystalline it bends easily without cracking on $\frac{1}{32}$ mandril but it seems to ~~be~~ ~~a~~ ~~bit~~ platinum bad I must get something that won't

Make a split mould with $\frac{1}{1000}$ hole put wire put wire through and stretch filter water through Repeat mould hot

Cover wire to $\frac{1}{100}$ and leave with ribbon fibre & wind the heat will cut off the fibre and leave wire and covering on loose

Coöum Dmds

Mix Magnesia with Rubber dissolved in Benzine in variable proportions

Mix Magnesia with Gutta Percha dissolved in Chloroform & Coal

Try plaster of paris on a wire and note shrinkage

Coat silk fibre with MgO by dipping in alcoholic solution of same and Croc wire regular way.

Mix Carbonate of Baryta and rubber in Benzine and coat iron by great heat it fuses & coat covered slag. non conductor

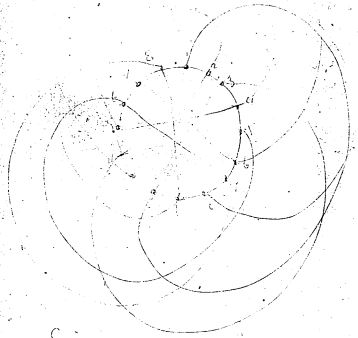
Coat with very fine ~~pipe clay~~ and ~~Fire clay~~ ~~clay fine~~ mixed with Mg O.

43

Goat Silk fibre with pipe clay and Mg O. laid up in usual manner

Deposit from Sulphate of Mg O.

No good too fluffy



Diagram

Apl 7 1919

Try Alcoholic sol of Mg O for coat, bring up in Vacuum before bending.

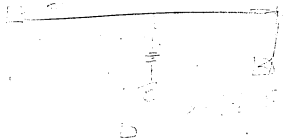
This is good, it is a little different to put on and it breaks up by contraction a little however there are not bad faults and can be got over but it still eats into the platina

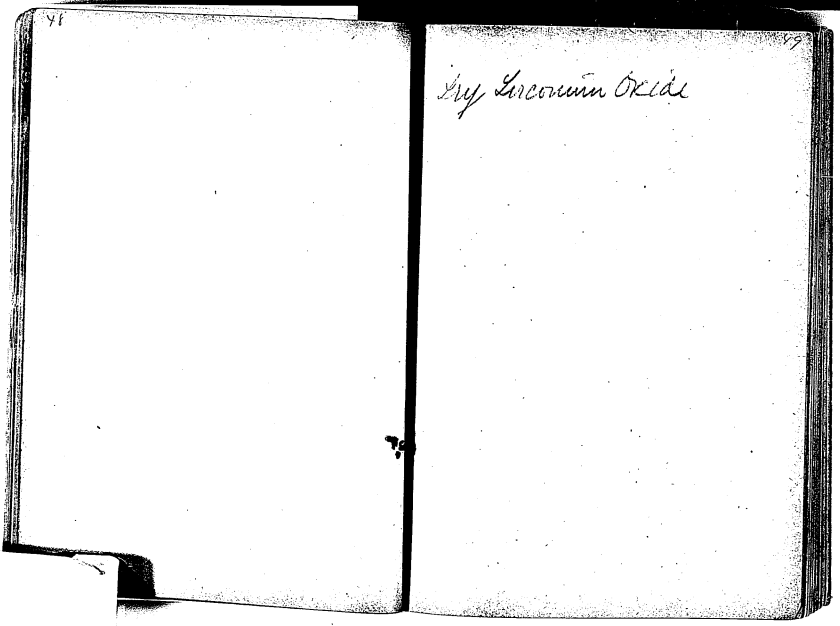
Try Alcoholic Solution of Butter for coat bring up in Vacuum before bending (Kitaninin)

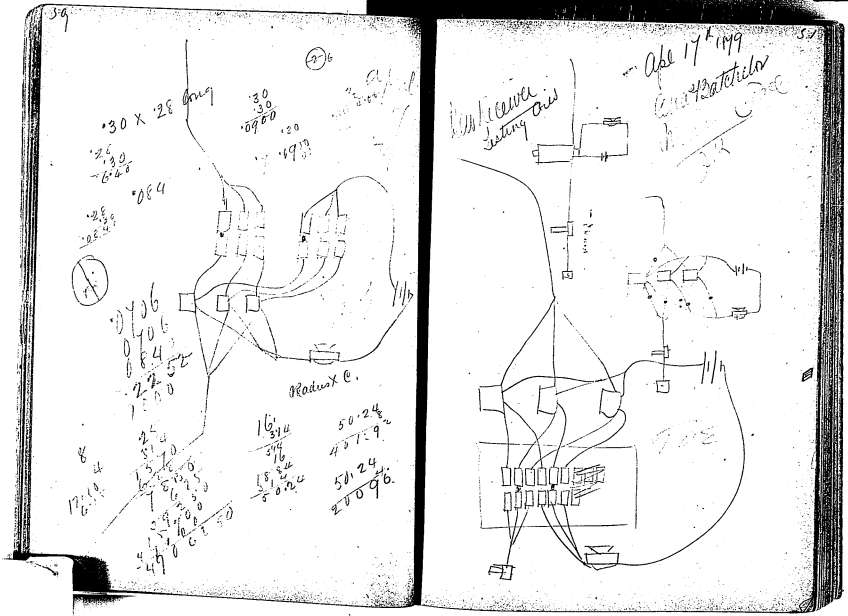
Chas. Batchelor

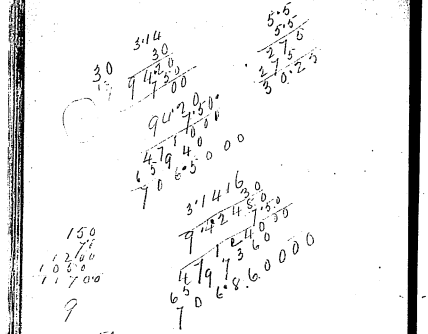
F.B.

Cerium Oxide + Oxalate









New Receiver. April 18th 1919

Made 2 coils for new receiver & compare with our original coil; our original coil is as follows:—

original coil Length 4½ inch
Thickness
No 1. Primary 4 layers of #19 resist .40 ohms
Secondary 9 layers of 32 resist 1.50 ohms

No 2. Length 2½ inch
Thickness
Primary 6 Layers 18 resist .35 ohms
Secondary 14 Layers 32 resist 1.57 "

No 3. Length 1⅜ inch
Thickness
Primary 4 Layers 19 resist .22 ohms
Secondary 9 Layers 36 resist 1.64 ohms

·09
·0706
·0706
·2312

·3
·3
·09

·30

Electric Light April 16 1879

Surface of Spool

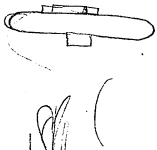
·3 X ·3 = ·09 + ·0706 + ·0706 =

·2312 square inch

This has ·010 wire on it covered to ·0145 and it held 10 feet 4 inches of wire = 1 ohms

54

Rondo Pent



Sharon

500000

12

14.

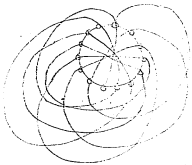
500000

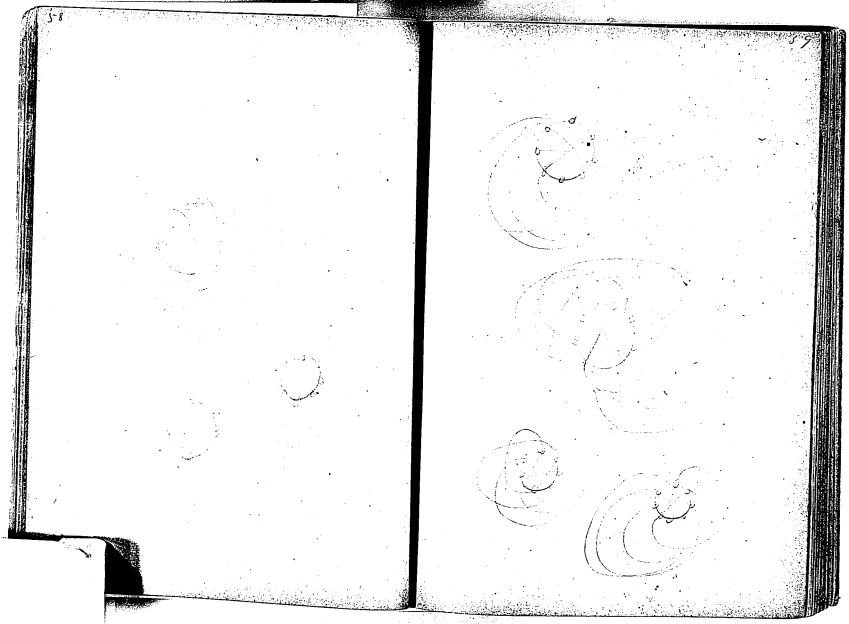
100.000000.

Make field magnet

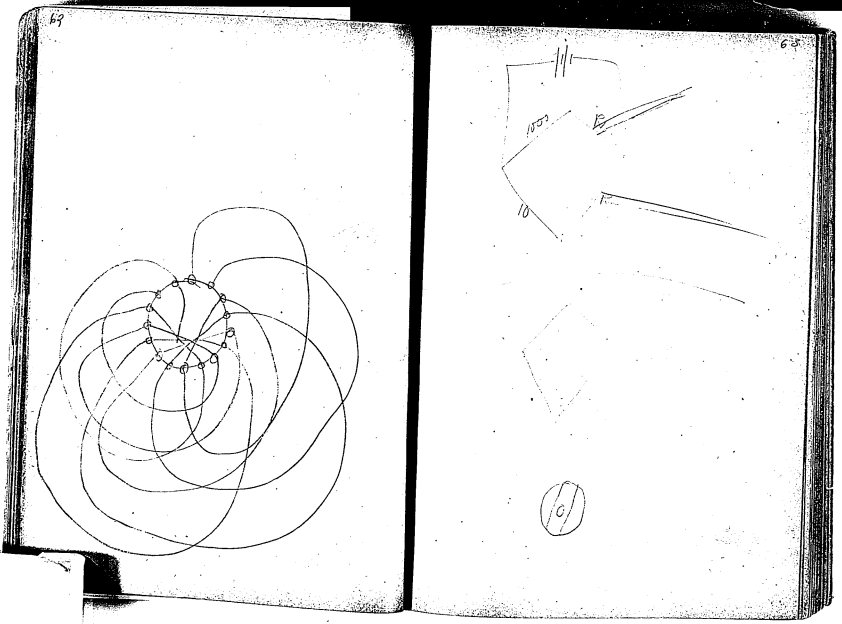
075 ohms

5 inch long + 1½ thick





60
61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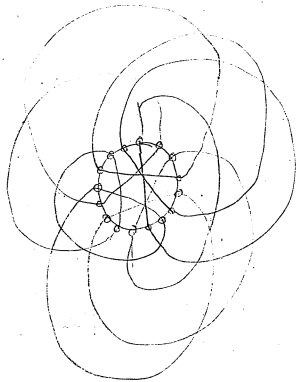
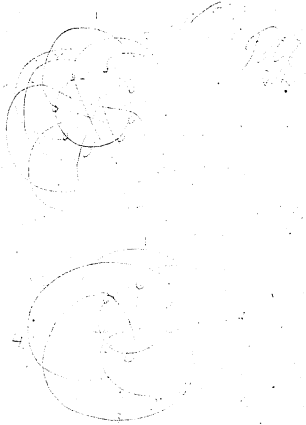
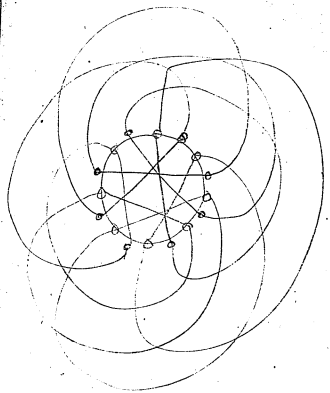
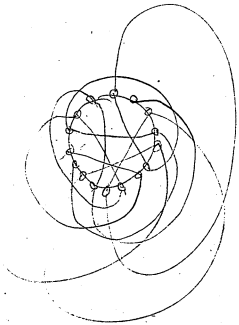
69
10
10









100. 15

60. per 100 ea.

6

24,000.

2,400,000.

400,000

2,400,000

1,650,000.

250 cap. 3

30, 150 3,950,000.

10 225

6000. 9

8000. 4

2,000,000, 1000, 3000,

5 250 cap. 4 hrs

1,350,000

Light

60. 225 2839 Kup

24

11356

13678

148136

100 1,400

1000 4000.

148 136

6

Light

2,300,000 1,333 888816

160,000 cap

4000 = Mosha

166

24

664

332

3984.

35

24. 4000 | 166 2/3

240

160

144

160

144

16.

16% mosha

of Co station

16%

11.69

16% 3.9

400 000 lights will require if 100 lights per machine, 4000 machines each using 350 per machine 1.400,000 - requiring 68.000 horse power, in 24 stations 2833 hpower in each. cost of this - power for 4 hours $ 2:720. Total Cost plant 6,000 000, interest at 10pc, 600,000 yearly

Interest. 600 000
Power etc. 992,800
1,592,800

Bypass. Consumers wanted hours in 4 hours at 4 feet per hour. 6.400 000 at 2 per M. $ 13 000 nightly or in year. 4.745.000 if at 1 per M. 2.372,500 at this price our cost 1 592 800
our profit at 779700 $1. per 1000

400
100
40,000

4000
100
400,000

1.600.000
4
6,400,000.

350
4000
1,400,000

365
13000
365
65000
78000
34000
4745000

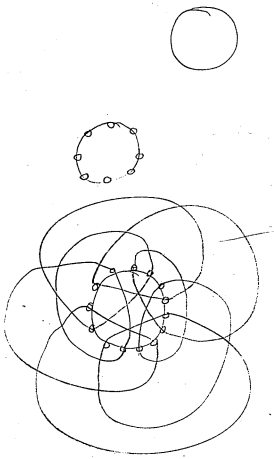
17
4000
24) 68.000 (2833
48
200
192
080
72
8
72

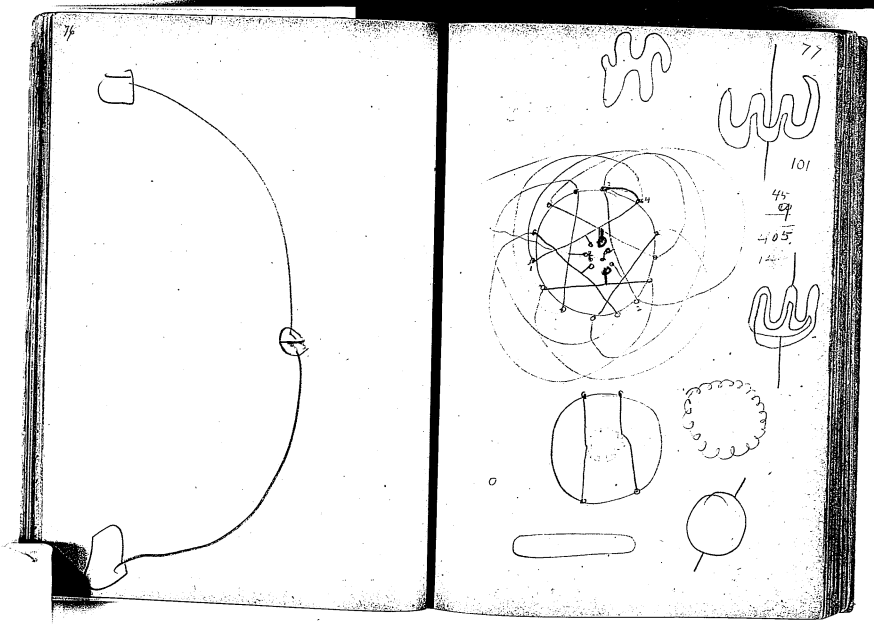
2720
365
73600
16320
8160
992800

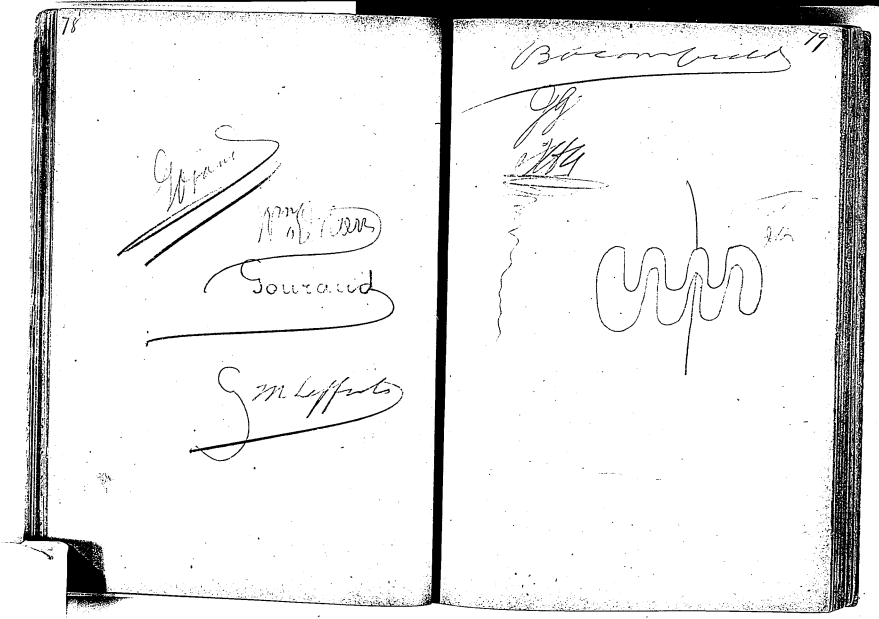
17) 68.000 (680.
6 8
8 0
8 0
0 0 0

680
7
2720

2 material on

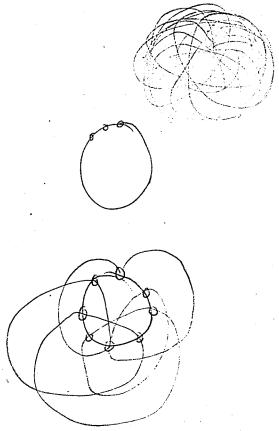



76
77
101
45
9
405
12



229.

229



20.
20
400

100
100
10000

2 ohm = .4. hp.

100 $\frac{1}{4}$ 10

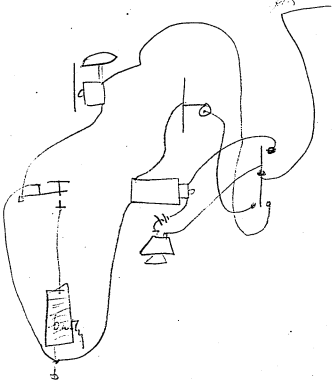
6. 400. 100.

3 hp. 2½

1.

1500
25
75 00
3 00
3 75 00 01

April 1894



15 2
30 1
6

24. 1 2
2 1
4 1/2
8 1/4
16 1/8
32 1/16.

1/4
1/8
1/16

32
15
160
32
48

1/16. .16 .25

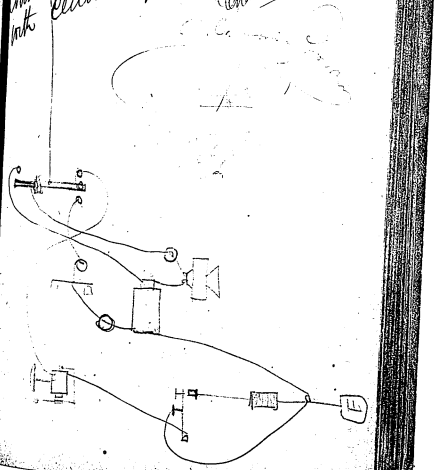
32

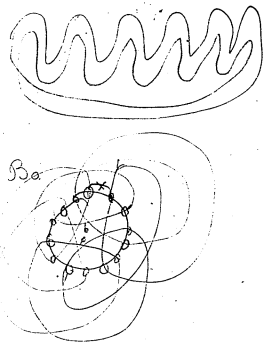
100.

1/4 ohm

1/18 100.

Edison Telephone
Connection for station working
with central system May 1st 1879
Charles Batchelor

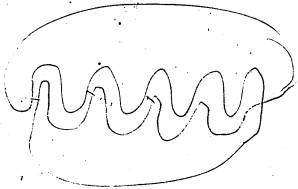


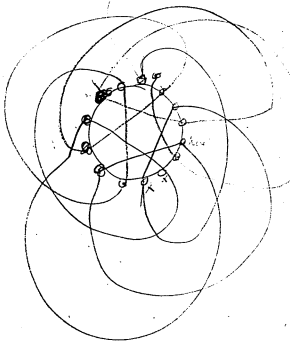


142	20 − 5		.15
12344	37 − 5	17	32
1466	55 − 5	18 − 5	0
1468	72 − 5	17	67
14610	86 − 5	13	81
14612	96 − 5	10 −	91
14614	106 − 5	10 −	101
14616	113 − 5	7 −	108
14618	116 − 5	3 −	111
14620	117 − 5	1 −	112
14622	115 − 5	− 2	110
14624	110 − 5	− 5	105
14626	105 − 5	− 5	100
14628	92 − 5	− 13	87
14630	80 − 5	− 12	75
14632	64 − 5	− 16	59
	71 − 5	+ 7	66
36	89 − 5	− 18	84

14

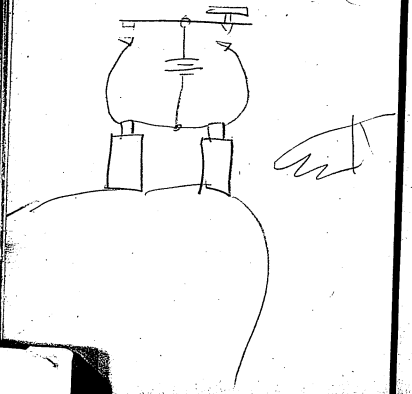
38	108 − 5	103
40	130 − 5	125
42	145 − 5	140
44	164 − 5	159





Telephone Call May 19 1879

Alexander Graham Bell



Reversing battery Coil 1800 ohms
with opening only 6000 ohms
had to bias it as opening
only worked it.

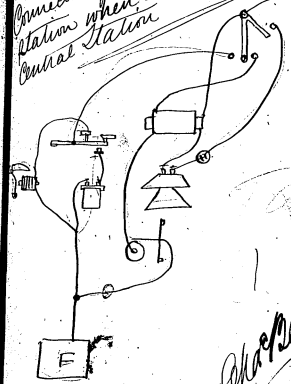
Double Coils 4600.

Limit

Earth

Edison Telephone
Connections for each
station when worked with
Central Station

May 1st 1891

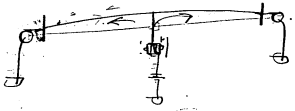


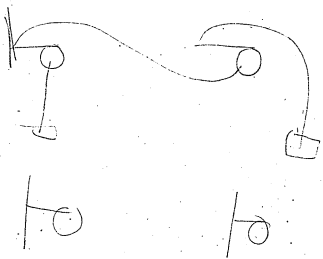
Chas Batchelor

Edison Telephone
Central Station battery

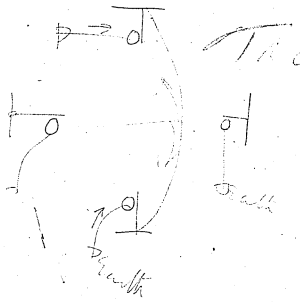
May 1st 1879

Charles Batchelor





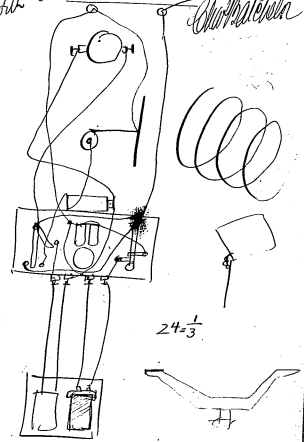
May 1877



Edison Telephone
Connections for station
working with central system

May 1st 1879

Blue Pencil Sketch



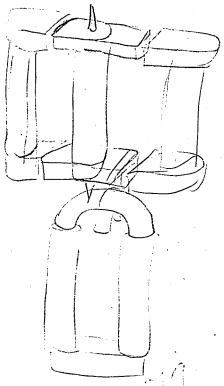
Portland

Portland

Portland

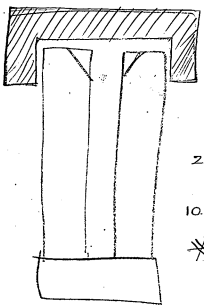
24 1/3

Batt wire —
Back-call wire
Transmitter
Key wire
Switch wire
Bell wire



May V 79

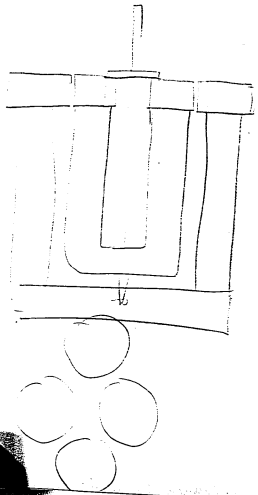
4 60 / 1200 (20
120
00

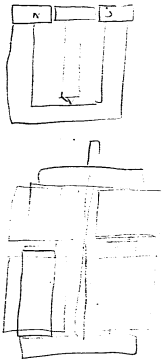


45

20.
20.
2
1000 00
10.

2000
200



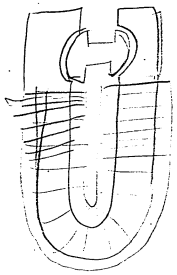

N
S

5000
100
500,000

200,000

Round

5000



75-

300, Round

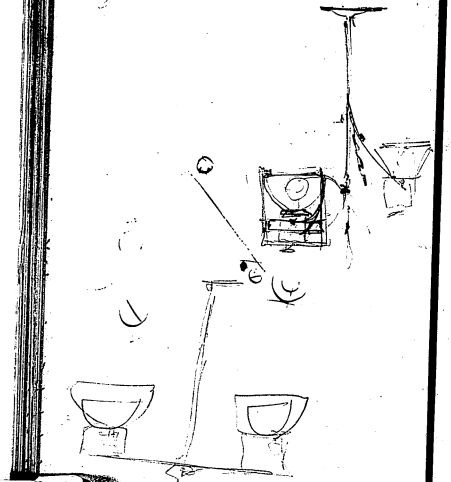
34 1/2

1 15 140, 1½ dozen

6-of 23. 70 70 — 35.

2/10. 35 35 — .35

106



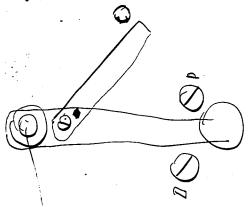
107

3

.9.

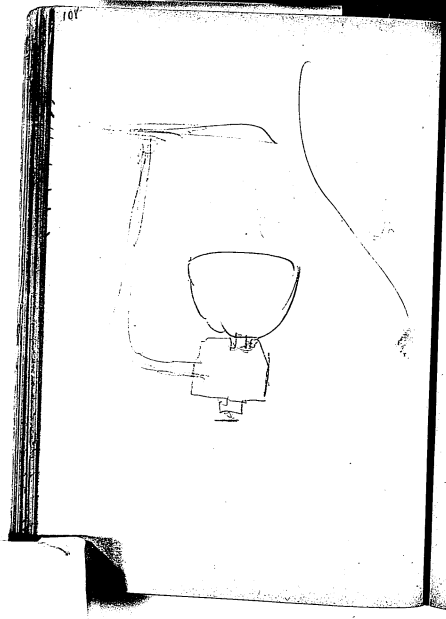
16. 1,140 (9
1,144

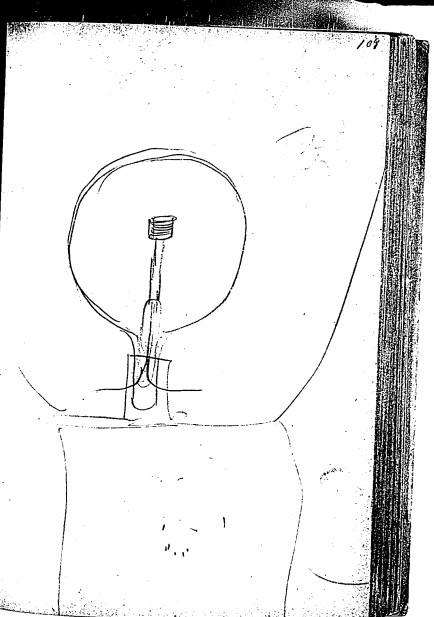
18.

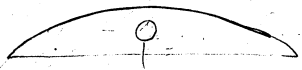


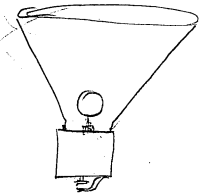
.9.

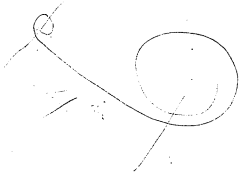
1,74

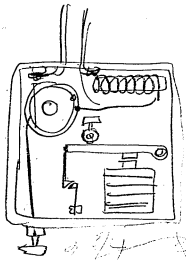


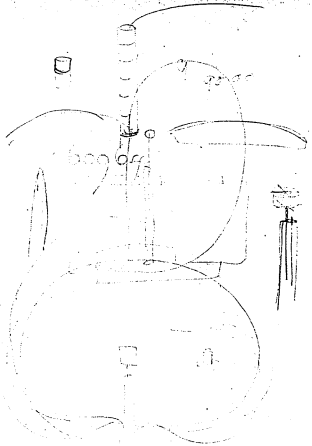


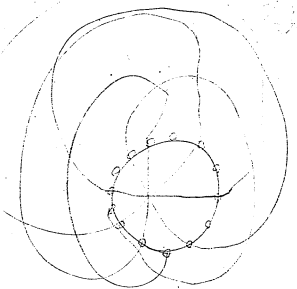


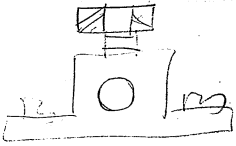








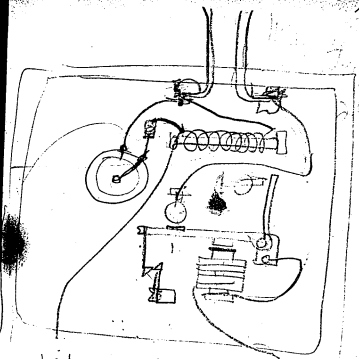




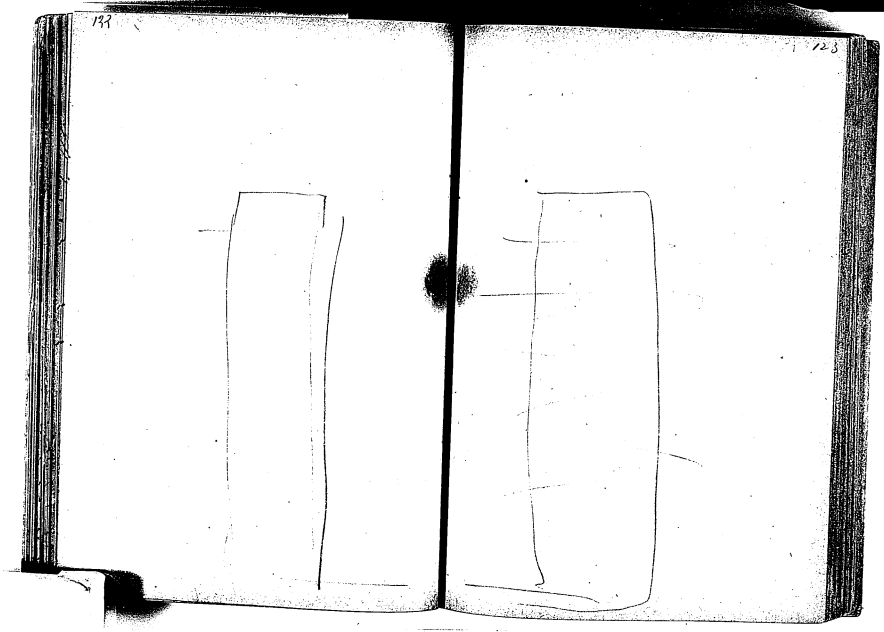
1/100

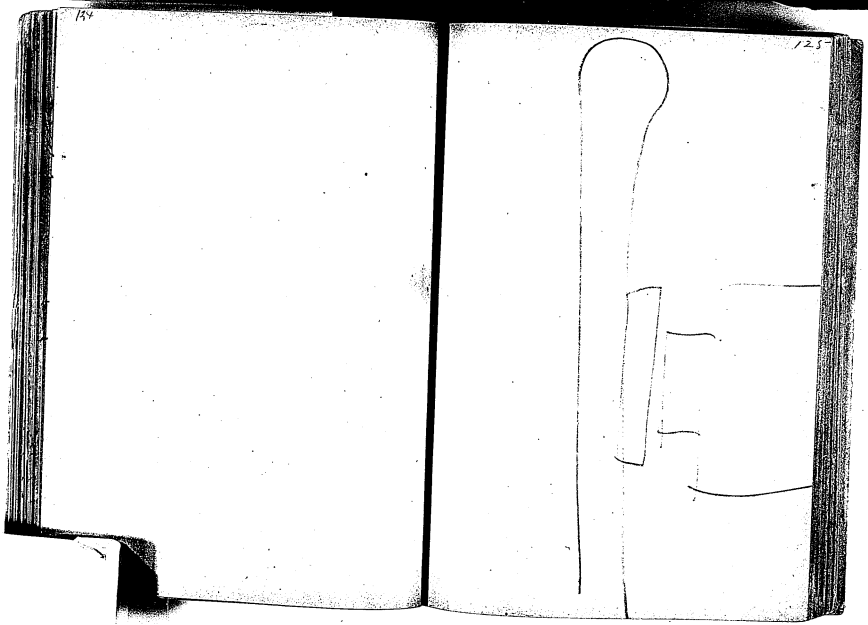
10 × 10 × 9 high

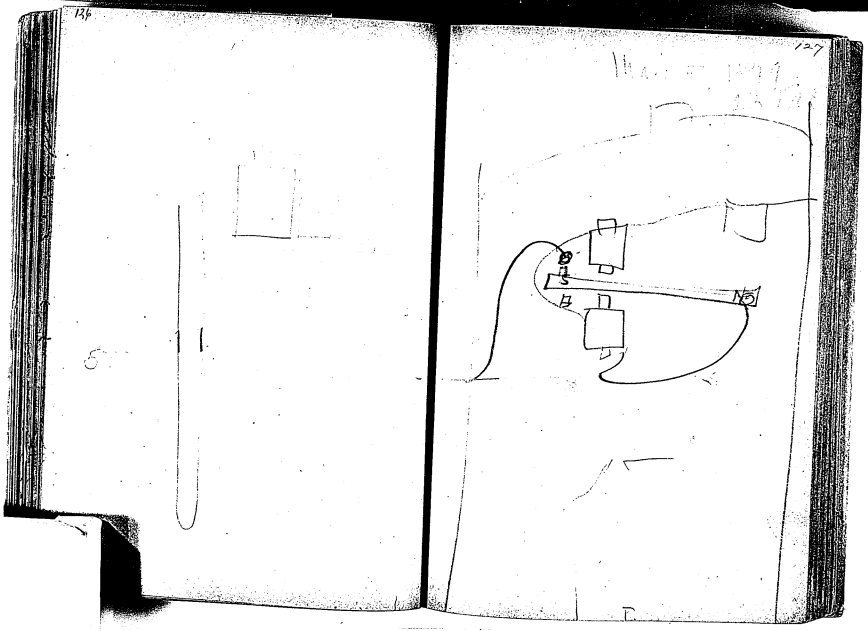
10 ohms.



Small Cistern


122
123


124
125



1000.

1 ohm
machine
250

1 ohm each. -

Then 500 hp Last?

Cost 250. 25000. -

Interest 10 pc 25000 4 years
300 days 10 hours 15000
Loss $15000. - 17500

1000 hp ——— 500 machines

1 ohm

Then 250 hp last

Cost 500 machines 7500.

Interest 10 pc 5000
30 days 10 hours 7500
Cost 7500 12500

1000 hp. 1000.

10 in Each.

~~Each~~ 125 hp Each.

Cost of 1000 hp 100000

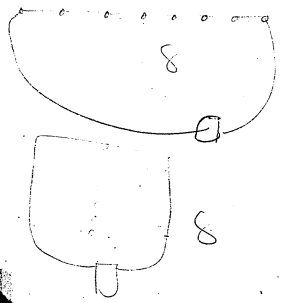
Initial 10 pc 10,000.

Cost 3 750

13 750

$\frac{1}{16}$

20.	1
40	2
80	4
160	8
320	16



$\frac{1}{8}$ of 1 ohm

or 1 of 8

4.

4	16
8	64
16	256

64

25 1/2 Campo

.50

1 12

100
100
10.000
100

80 1/8 = 8 Inches
8 1/8 = 1 inch

100 x 50 / 100 = 5000 / 100 = 50

2 50 25
4 25
8 12 1/2

50 25

5 20
12

2
4
8

Thomas Williams — May 10th 1849

@ Hartshead Wire

Wire for armature —

#22 wire double covered = .95 ohm per ft

#20 wire = 118.5 per 1000 ft

#20 wires 3 together = 355 ft = 1 ohm

#20 wire 2 together = 237 ft = 1 ohm

Diameter Circumference of Shell 27.79 inches

length of one turn 39 inches

Wanted 4 ohms in toto = 948 ft of 2 wires

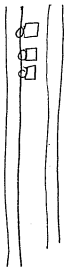
or = 1422 ft of 3 wires

or = 474 ft of 1 wire

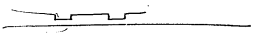
With 5 layers of 13 turns of 3 wires .95 ohm = 901 ft.

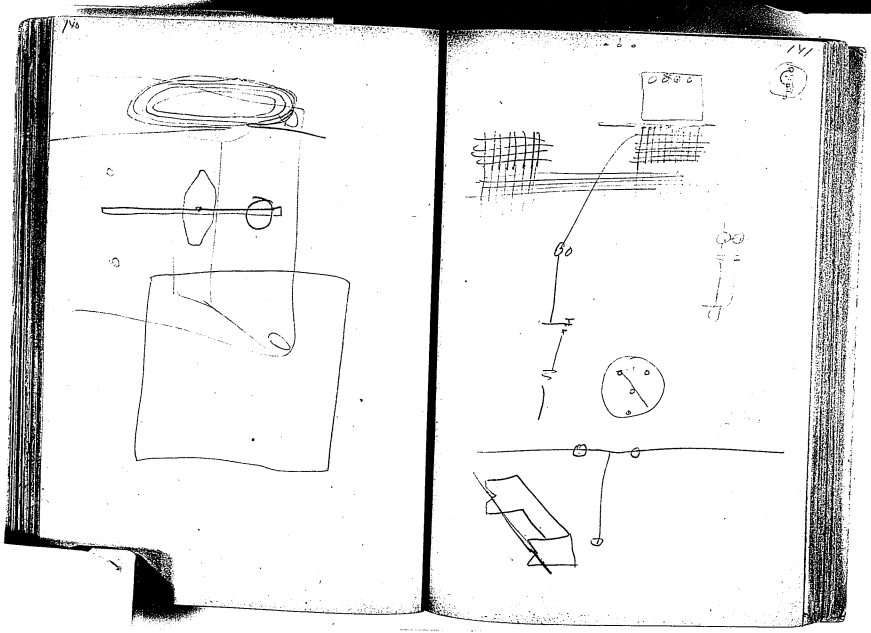
with 29 coils 58 divisions giving .03 for division and .45 in space.

Cut 78 divisions of .31 wide and .3 deep.



44
22
176
264
3/2716
9 0 8
1 8



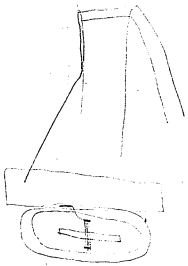


102

103

May 10 1879

Tom



100. unit 10 per year

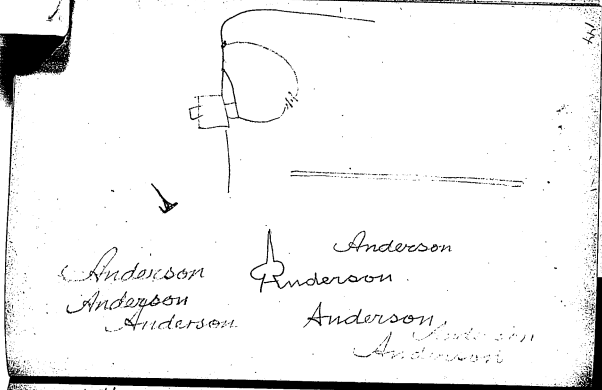
4 hp. [illegible] 140 150

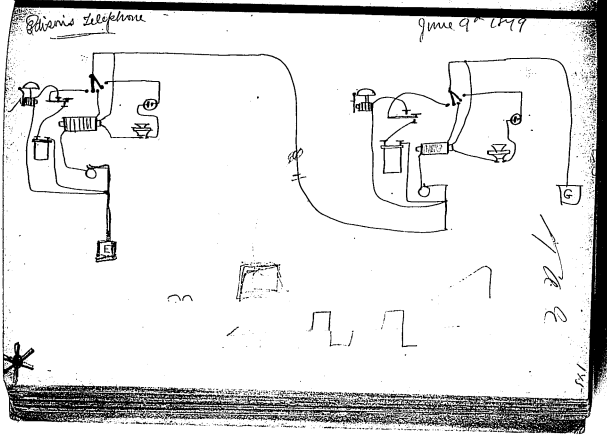
next 2 hp.

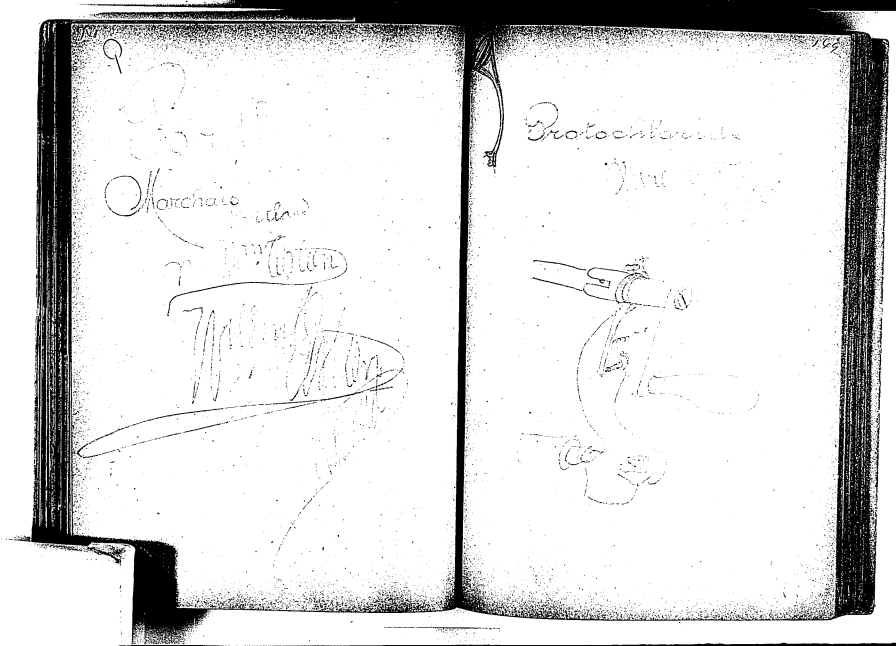
200. 120.

160

3½-


Anderson
Anderson
Anderson
Anderson
Anderson
Anderson
Anderson


Edisons Telephone
June 9th 1879



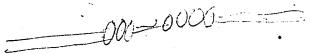
1250

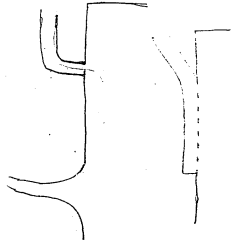
~~2500~~

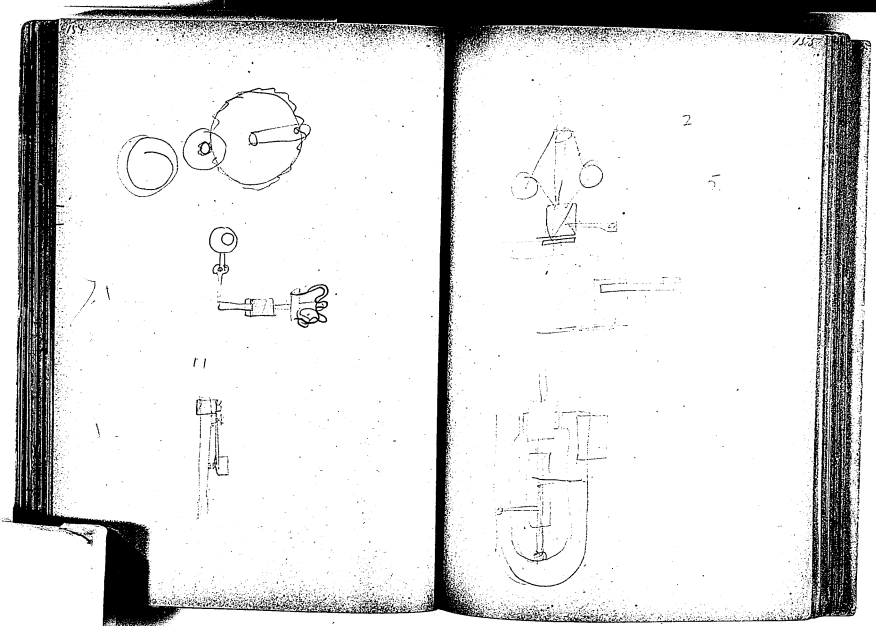
1833
2666
7700
2000
12000
19199

1250

19,199
~~20000~~
17.
125
17
108000







6	Bridg pins complete	15
5	Heads do.	.21
3	Finger Springs	15
3	" "	3
3	Spring washers	15
2	Tuners, Diapasons	20
2	Keys "	50
3	Damper wood rings	6
1	Nuts pieces pallings	60
3	Stems do.	10
1	Keys Springs	50
2	Tuners stopping	18
5	Tuners stopping	45
4	Key Buttons	15
1	Mouth handle	8
2	Keys Pallets	45
2	Tuners "	45
2	Tuning pins	20
3	Keys finished	
8	Rockbutton springs	
3	Rockbuttons complete	2.00
6	Berry mouth pieces	3.00
2		

22

1200
3 1/2
600
3600
Cyl 600

2400
600
3000

1/
1250
1250
1250
3750
3.000
1/25
125
4200

4 1/2
1 1/2
2
6 20

250
250
3.12 1/2
10
$12.50
37.50
15.00
$37.50

365
15
1825
365
5475.

Condenser

1200 H.P.

Condensing engine
allows economy in
pays interest on $5000
in coal alone
when Condenser 2 1/2 lbs per hour
now 3 1/2

$9.600
1200 H.P.
1/3 less Wages of Miller
Roomman
1/3 less depreciation

6 X $200 $12.00

Saving on firemen $1460

Saving in rent

Against this

Extra cost of Non condenser

250 | 8.50 $34
25 20
100 68
408
12

6.80
1200
$ 12 1 60.00

Extra cost of

Depreciation

Cost of piping to be reckoned

32000 Pipe
1280,00 Ends
33.280
11,000

~~Total Extra Expense~~

2.50
1.25
3.75

1200) 3000 (

1200) 375.0 (.31
3600
1500

$12
$16

1200) 1.60 (.0013 1160
1200
400

.13
1600
.016 Oil Water

3650) 5000 (1.4
3650
13500 1.35
10600

1200) 1350 (.11
1200
150

Cost per H. P. per hour

.31 Coal
.13 Labor
.016 Oil &c
.11 Rent
.13
.022 for Repairs
.718

Coal 1½ lbs
for 1200 H.P. per hour
.105 for Water
.75 per H.P. per hour

76000 for
663
$7600

2650) 7600 (2.8
5300
2300

1200) 2650 (1.7
1200
8000

1.7
.17 cts

.17 cts for interest
.10 cts depreciation
.175
.92

Cylinder 14 X 24 inches

14
14
56
14
196
31
196
588
6076

42) 3,038,000 (72.0
294
98
84
140
126
14

12.5

3650

2.38) 2280.00 (958
2142
1380
1190
1900

958) 3650 (3.1
2874
1260

958) 3650 (3.8
2874
7760

3.1
5
$18.60

3.8
8
2

168

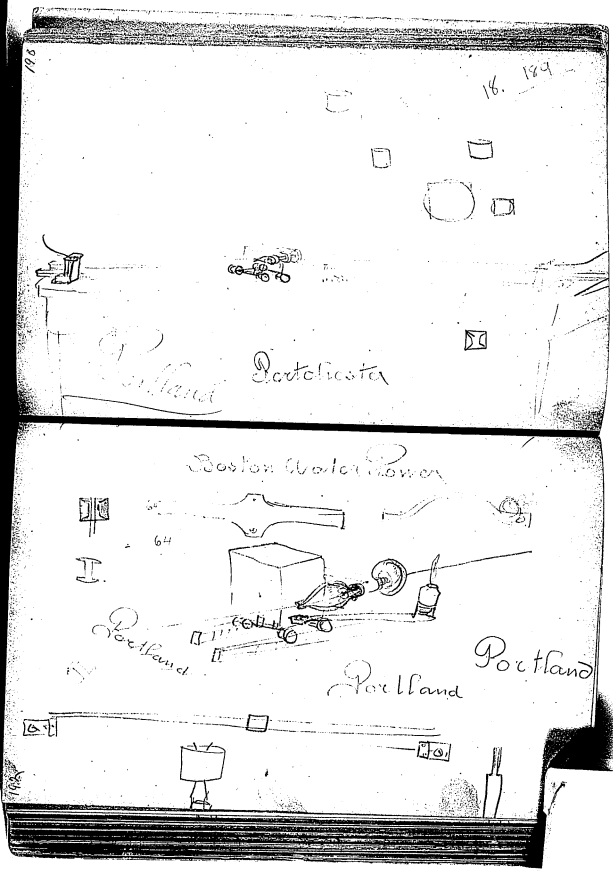
.93
31
.62

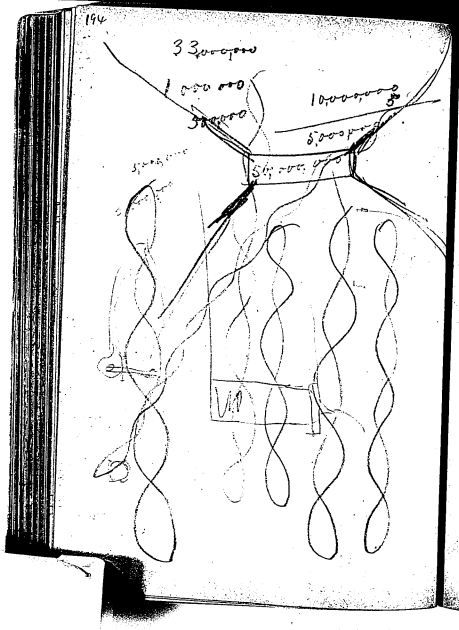
156
3
.468

4.6
.5

2240) 3500 (1.56
2240
12500
11200
14000

169


193
16. 189 -
Portland
Portland
Portland
Boston Water Power
64
Portland
Portland
Portland



~~.042~~

.075
.013
.062
4
.248

.031
.031
31
93
.0009 61
3.1 cu
3844
961
2883
.002981754
1.05
2.5
.0425 Tot Cu

1.82

1.82 .2601
16.6 1.2201
1.4802

30.2

19.8 cu ft in M cont

40.2
29.4
45.2

60
40.8
40.2

~~.097~~

190
14
204) 16.6

1.2201
2.3096
2.9105

8.14%

204
1.4802
2.3096
1.1706

14.8%

1.6042
2.3096
.2946

.6551
.3096
.3455

1.18
16.6
19.6

.0719
1.2201
1.2920

60
19.6
40.4

1.6064
2.2096
1.2968

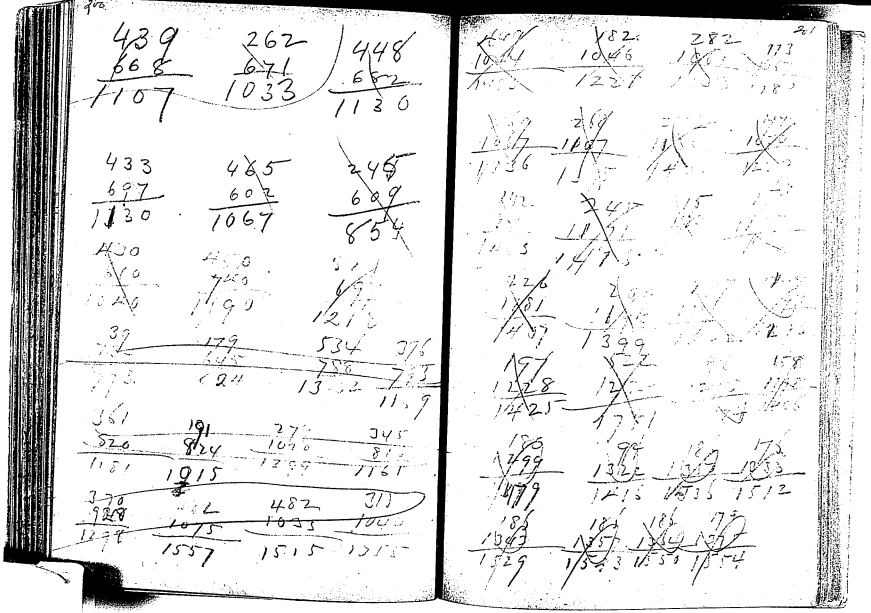
40.
19.6

75 cts.
19.6
55.2

1.7419
2.2096
1.4323

27.1
13.6

28



290 1391 1681

154 1399 1553

170 1403 1573

35 1446 1481

A 1681
B- 1761
1824
1664
1999
1816
1697
1609
1732
1759
1783
1709

159 1404 1563

159 1407 1566

149 1414 1563

336 1425 1761

112 1453 1565

112 1465 1578

112 1478 1589

112 1512 1624

128 1536 1664

482 1517 1999

87 1529 1616

170 1542 1712

143 1555 1698

57 1512 1569

43 1500 1543

30 1562 1592

30 1563 1593

30 1560 1590

24 1566 1590

32 1522 1554

160 1572 1732

15383
1757
17,140
1600
1600
1585

2 1605-9

9 | 15783

10 7/8

2 1/2 inches

~~3/16~~ 3/16 of it 1/3 less in width

---

2 1/2 3/2 again the resistance

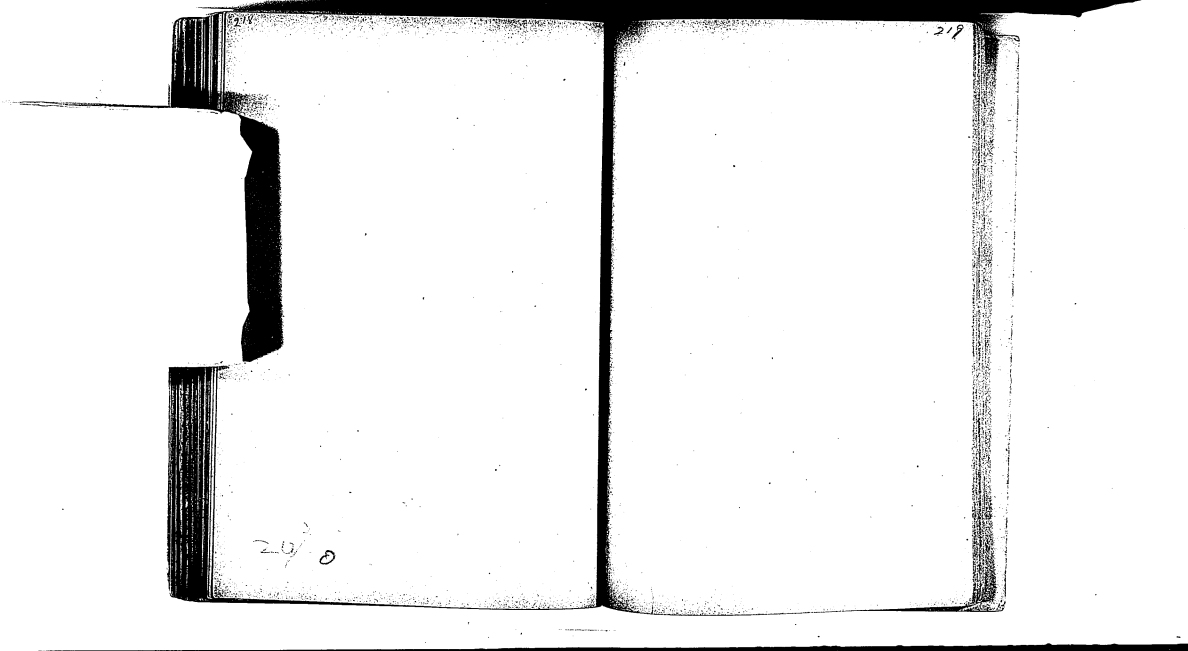
~~3/2~~ 2/3 the surface

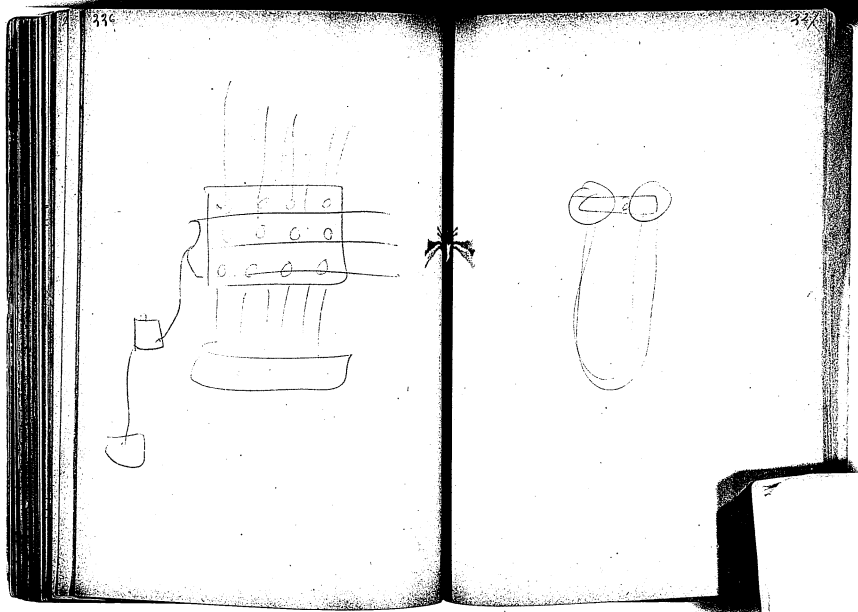
2 1/2 inches

3/2 the energy

3/2 X 3/2 = 9/4 = 2 1/4

2 1/4 times the temperature





To spirals

See Satanic, Nide, and the other Zones from the Nide & water.

5.20	all	1
5.40	1	0

10000 Campos 8 pr H

2 2.5
365
2.35222
2.56223
4.91445

4½ hours
5 hours
$82,100 M
82
$1.00 per M
250,000

$/23
1.36217
2.56223
3.92440

$8,400 Labor

3600 3.55563
Coal 2240 6.64998
5 1.17612
365 2.56223
3.94445

$8,560 Coal

1000 Waste Lite

$/12 1.07922
2.56223
3.64145
$4,300 Executive

$5,000 Rent +

$2,000 Water ?

$6,250 Depreciation 5%

Total $82,100
$35,830
$46,270
$155,000 30%
15,500 10%

3 | 7000
2333
4667

3 | 5500
1833
3667

3867
1.02
7734

7000 2
42500 03
12750

4 hours
$3.21
2400 | 321.00

24000 1.8
7200.00

6 [illegible]

12240

2240 | 3500 | 1.5
2240
1260 0

1250
5 hours
5750

3
2248 | 17250 | 7.7 Tons
15748
1770

3.50
7.7
2450
235
2585.00

284 | 2585 | 10.3
250
85
750
100

$10000 rent

9000) 100000 (11.1
10,000
1,000
365000

14) 20 (1.4
14
60

250
365000
91250
.575 cts
456250
638750
456250
523.687.50

$523

5230

Found $5.00 more on conductor

.575

45 cts
50 cts
5 cts

1.72) 5.00 (.029
3 44
1560

1.72) 1500 (8
1376
124

29
3
87

29
29
319

1560

29
9
261

If 300 H.P can be sold during the day

600
30
18.000 lbs per day

2240) 350.

2.5441
3.3502
1.1939
4.2553
3.4492

.1562 lbs

$28.10
9.33
$37.43

37.43

1.5733
2.3802
1.1931

Cost per M 15.6 cts

If one horse power gives 40 feet an hour

40 X 600 = 24.000

240 M per day at 50 cts

$120 per day
37.43
$82.57

$30.100
15.5.300

19%
3
22%

1.9168
2.5623
4.4791
.1912
1.2879

240
.60
144.00
365
52.500

2,15-84
2.56 23
4,72 07
5.19 12
1.52 85

33.77
9
42.780

240
.75
365

2,38502
2.56 23
4,94 25
1 45 51
4,81 76
5.19 12
1.62 64

42.3
17.
5-9 07/8

600 at Station
400 at Consumer

$150 a year
300 days a years
50 cts a day
5- cts an hour

50 cts a M
~~100 kw an hour~~
100 kw an hour
1 H.P. at Station
240 cu.ft. an hour
6 1/2 H.P. at Station
60 cu.ft. an hour
must be charged for 1 H.P. at consumer
Conductor must be increased
1/2 or $1.25 per lamp
$12.500 more plant

$37.43 cost 600 H.P. at station
10 hours

300 / 125.00 4.0969

41.66

$4.16 Interest 10% on condensator

$37.43

$41.79

18.71

40
600
24000
10
240. M

$120 at 50 cts.

$120
$37.43
$82.57

300
100

60 feet a 50 cts
5.0

3 cts [illegible] an hour hauler

15-5.333
12 5-00
16.7833

1.9168
2.0771
4.7753
9.1692

14 %
3
17 %

1/2 200 H.P. at 50 cts.

7%

200 H.P. at 60 cts. 250 $3 Table

240 M
12 & M
60
$7206
18.71
$53.29
300
15987.00

4.2038
4.7753
2.9791

9.5 %
9
85.5 %

1/2 at 50 cts 7 %
1/2 at 75 cts 16.1

120
300
36000
9
27000

4.4314
4.7753
1.2061

16.1 %
7
17
40.1 %

1/2 at 50 cts 7 %
1/4 at 75 cts 8 %
1/4 at 90 9.6 %

36000
9
324008

16000

4.5105
4.7753
.2858

24.6
.26
50.6 %

4.2553
4.7753
.0306

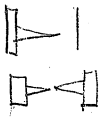
1/2 at 50 cts 7
1/4 at 75 8
1/4 at 1.00 10.7

25.7 %
3
5.77 %

2 10

300 days each year for power

50 cts for M
10 hours a day
3000 hours a year



60 feet

50 1.6990
16.6 1.2291
.4789

3.01 cts an hour

3.00 cts. an hour
Cost 1.18 cts an hour
1.82 profit

3000
5460.00
400
4860.00

50 ct
5 ft. 30
30 cts.

$19,440 profit a year
204.000 capital

204. 1.2878
2.3096
1.9782 9.5

12%

182
17
364
182
2184 0 | 204 | 10.7
204
1440

21.840

60
16.6

1.7782
1.2201
.5581

3.61
2.000
400 120000 6.

.5581
2

3.61
120000
722
361
43.3 20000 = 1.3
204
408
272
2720
680

60
16.6

75 cts
60 cts.

At 75 cts. per M

4.5 cts. an hour
1.18

60 cts.

3.61
1.18
2.43
12
286
243
2816 00000 (13.58
204
776
612
1640

60
50
16.6
3.30
49.8

60
3.00
√ 20
16.8

75 cents per M
is 4.5 cts. for 60 feet
cost of 60 feet

4.5
1.18
3.32 cts

204 | 39840 | 195
204
1940
36

17.3

15.9
9.5
226
48.0
9.5
254

90 cts

6 9 10
90 X 5 = 3/3
75 15 12 8
25 12 7.5
21.5

204 | 25.22
204
482

87
5
6.6
1.18
5.42
6

5.4
1.18
4.2 2
6
25 32

204 | 3252 | 15.9
204
1210
1020
190

$1.00
600

6.48
1.18
4.82
76
204 | 2892 | 14.1
204
852
816
36

14.1
18.6
327

14.1
9.5
23.6
20.5
541.8

204 | 2532 | 124
204
492
408
840

28
24
82

125
75
1.18
6 3 2
6

204 | 377 2 | 18.5
204
1752
1632
120

9.5
28.1

5

9.00 cts.
1.15
7.82

10000 cut
10

204 | 4692 | 23
408
612
40 sq ft

3 | 2240
746
40
29880

24
14,1
381
54
921

3.75
9
3
2
140625

2.25
2.25
5.25
5.0625

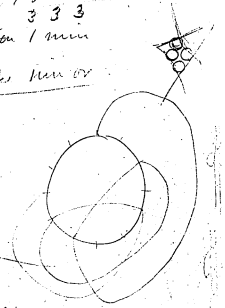
2.25
4125
2.75
5.625

25 - 4 ft

4" x 100 = 2500

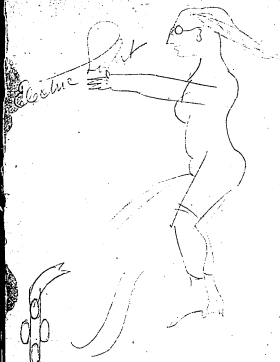
33 000 ft on 1 min

333 1/3 pas p. min or



345
345
1554

H 90
90
8100.



Menlo Park Notebook #37 [N-79-07-07.1]

This notebook covers the period July 1879-May 1880. Most of the entries are by Francis Upton. There are also entries by Edison. The book contains numerous notes by Upton relating to articles in technical journals, including notes on an article by John Hopkinson on generators, which appeared in the May 9, 1879 issue of Engineering, and draft letters to the editor by Edison and Upton concerning this article. There are also notes, calculations, and occasional drawings relating to dynamos and electric power distribution; notes by Upton on a proposal by the Holly Water Works Company to supply engines; and notes on "Laws of Winding Dynamo Machines." The label on the front cover is marked "Upton," "Statement as to power & c," and "Electric Light." The book contains 284 numbered pages.

Blank pages not filmed: 42-43, 136-139, 230-231, 236-237, 248-249, 260-283.

Burglar Machine 176

LIBRARY OF THE

BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

_____, 189_

#37

128 lb

1000 Lamps 100 ohms each

Every 10 lamps of 10 ohms there is two conductors total R of 1 ohm

Cost 1/4 mile $30 per house a year 70

217
25
1085
434
5425

1000 feet

.3

T69/4

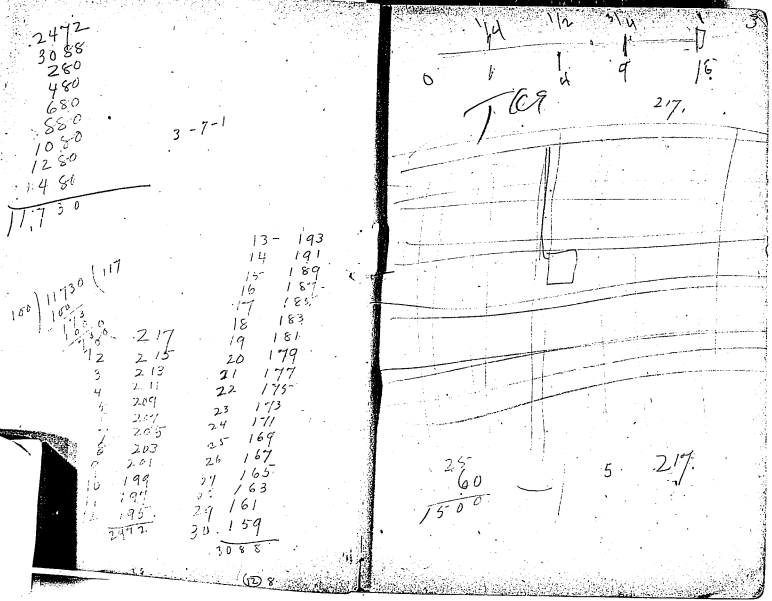
1/2

3/16

1320
20
132,00

264.16

2640


2472
3088
260
480
680
880
1080
1280
1486
11730
3-7-1
117
100
217
215
213
211
209
207
205
203
201
199
197
195
2912
13 193
14 191
15 189
16 187
17 185
18 183
19 181
20 179
21 177
22 175
23 173
24 171
25 169
26 167
27 165
28 163
29 161
30 159
3088
1/4
1/2
3/4
1
0
4
9
16
TCR
217.
25
60
1500
5
217.

31 — 157
32 — 155
33 — 153
34 — 151
35 — 149
36 — 147
37 — 145
38 — 143
39 — 141
40 — 139

1480

41 — 137
42 — 135
43 — 133
44 — 131
45 — 129
46 — 127
47 — 125
48 — 123
49 — 121
50 — 119

1200

51 — 117
52 — 115
53 — 113
54 — 111
55 — 109
56 — 107
57 — 105
58 — 103
59 — 101
60 — 99

1080

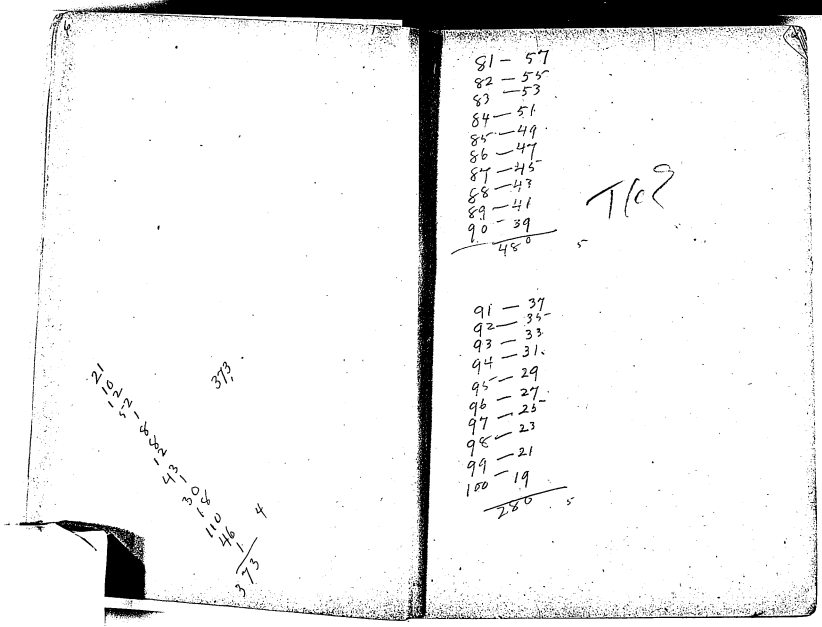
61 — 97
62 — 95
63 — 93
64 — 91
65 — 89
66 — 87
67 — 85
68 — 83
69 — 81
70 — 79

880

71 — 77
72 — 75
73 — 73
74 — 71
75 — 69
76 — 67
77 — 65
78 — 63
79 — 61
80 — 59

680

TOT


81 — 57
82 — 55
83 — 53
84 — 51
85 — 49
86 — 47
87 — 45
88 — 43
89 — 41
90 — 39
480
91 — 37
92 — 35
93 — 33
94 — 31
95 — 29
96 — 27
97 — 25
98 — 23
99 — 21
100 — 19
280
TCP
373
21
10
12
5
8
8
2
43
30
8
110
46
4
373

Thames embankment

Experiments Engineering 26 Oct 88 p 417

Fuel consumed per indicated H.P. 3.86 lbs of coal on a 20 H.P. engine

Power absorbed in driving engine and intermediate shafting 5.19 H.P.

Gramme machines 7.21
5.19
2.02 H.P

1 H.P. required to drive the Gramme machine at its speed

When the current was passing in the Gramme it took more power to drive the machine exclusive of the work done on the current

This is owing to the magnetic

34.17	1.53337
13.417	1.1277
2548	.4060
25.77	1.4110
12.57	1.0979
2.056	.3131
20.81	1.3183
12.08	1.0820
1722	.2363
17.44	1.2415
11.74	1.0697
1485	.1718
15.05	1.1775
11.50	1.0607
1308	.1168
13.27	1.1228
11.33	1.0542
1.171	.0686
11.19	1.0755
11.19	1.0489
1.084	0.0366

9.17 H.P
7.21
1.96 H.P. Tile

About 1 H.P. more required than this was measured & do not know. That is 2 H.P. consumed in driving each 9 running

13.17 H.P for 8 lights
9.17 H.P machine
5 H.00 H.P.
.8 H.P per lamp

13.17
7.21
5 5.76
11.17 H.P. including the machine

For Incline Dynamo

5 Lights	1.59 HP each
10 Lights	1.27
15 Lights	1.03
20 Lights	.90

Showing that there is a gain by subdivision of the lights.

10 lights

17.93
9.17
8.76 H.P. for 10 light
.87 H.P per light

TWR

15 Lights

20.75
9.17
15 | 11.58 (.77 H.P
10.5
1.08

20 lights

23.53
9.17
20 | 14.36
.716 H.P

Burned for night
5.5 hours

Coal .170 per ton TLE

48 cu. ft. of gas for 2 d.
per hour

48 for 4 cts

20.82
4
83.28

48) 1000 (20.82
96
400
386
140
8

1 foot cost
.083

83.28 cts per 1000 feet

5 foot burner
.083
5
.415

4.1 mills per hour

16

17

3.5 d for hours for

83 feet

7 cts

T. & E

83) 1.000 (12.04

83

170

166

4000

12.04

7

84.32 cts

exact per 1000 =

1 d 9 8.5

25

9

225

4.84

2.25

119

$ 7.28 per night

5.5 hours

23.53 N.P

23.53

5.5

11765

11765

129.415

9 | 7.28 (5.6
6 4 5
8 3 0

5.6 cts per hour per H.P

This is inclusive of attendance
rent Lamps &c

Material used
1 coal
getting of stone

3. 9.5
9
.3
1 7
6. 4.5

1.50
9
1.59 for material

129 | 1.59 (1.23 cts per hour
129
300
258
420

Conducting cable

£ 390

5

£ 1950

THE

2 Gramme machines Coal

£ 360

5

£ 1800

£ 900 each

42

43

Engineer testimony before Parliament ... M. 1221 p. 380

Mr. Samuel Hunter

40000 tons of coastal ...

4000 / 7 8 5 6 7 4000

1 2 8 9 1 feet of ... for ton

18 thousand ... feet for ton

... Protected ...

£ 400 ... capital

... 000 ...

71 5 6 7 0 0 0

357 ... feet ... dollar

357 on feet ... dollar

per year

24

55 to 74

X::
65 : X :: 74 : 55

65 / 2 / 3 / 2 3 0 / 2 7 5

74) 5 7 5 (4
2 9 6
6 1

74 / 55 / 2 / 3 / 2 3 0 / 3 | 7 5

74) 5 7 5 (4 8 3
2 9 6
6 1 5
5 9 2
3

25

10 cts a year interest
on 357 cu. feet

357) 10.00 (.028
714
2860
2499
361

TAG

.028 cts per cu foot
for interest

4 [illegible] =

£ 133.014 income
44.142 [illegible] including [illegible]
£ 88.872 expense [illegible]
5
£ 444.360

~~[illegible] 744.~~

The

715,570 thousand feet

715) 44400 (62 cts
~~[illegible]~~
4290
1500

Cost of gas 62 cts per 1000 feet

Mr. Farrer permanent
secretary of Board of Trade
Lights at sea
Lady Ford

1905 1d3

Houston & Thomas

.737 5/6

442.34

44.238 Yl. Hs.

Taf.

Used .12 chronometer galvanometer !

W0SIP3

42 1.6232
42 1.6232
2.08 .3151
44.3 1.6464

5.2109
162500 4.5185
32000 .6924

TW

4.92 H.P.

Engineering.
May 9, 1879.

No. 5

~~5.28~~
3.84
3.84
18.5

No. 5.

Ohms 3.88 Ohms a current of 18.2 Webers

8) 9
1.12
1.08

Tait
Volts

$W_1 = \mathcal{E} Q$

$Q = \frac{q}{8} \times \frac{a+b}{c} \times \frac{1}{c_2}$

$\mathcal{E} = Q R$

$W_1 = \mathcal{E} Q$

E. Mass Daniells taken as $\frac{q}{8} = 1.125$ Volts!

3.88	0.5888
18.2	1.2601
18.2	1.2601
1285,	3.1090

To find no need to convert Erg tens & Gilb

1.179 Erg tens equals	6
1.59 H.P	4
1.59	0.2014
38000	4.5185
	4.7199
52,470	.0714
1.179	4.6485
44520	

~~That~~ If in No. 5 E^2R is fulfilled we have 1285 as the number arising from multiplying them together, or that as of Erg sevens

38

The Siemens comments

86.4 of the energy into gives it in electricity exclusive of friction according to our measurements if a Daniell = 1.125 Volts or $\frac{9}{8}$

Hopkinson would have found that the Edison, which we made to give back 93% of the energy, gives back

96.7% of the energy over twice as good as the Siemens

39

To convert this into ft. lbs, Hopkinson used as multiplier 44,52 instead of 44.3 that I used TRC

1.125 Volts = 1 Daniell Hutchinson

1.08 Volts = 1 Daniell Ayrton

1.08	.0334
1.125	.0512
	.9822

96% of his measurements to be taken to equal ours

$\frac{96}{86.4}$ We should measure % of the energy converted by the Siemens exclusive of the friction

32
32
64
96
1024
.2
2048
44.5
10240
8192
8192
9113.60 ft lbs from 32 Watts on
.2 ohm

1.125
1.08
1.042

.0512
.0334
.0178

1.042 %

Remeasured 93%

93%

1042
93
3126
9378
96906

Then Hopkinson
method the Edison
a 96.9% machine

Your Journal of May 9
1879. Contains a paper on
Read before the Institution of Mechanical Engineers
Electric Lighting 1/1 by Dr John
Hopkinson F.R.S. in which some
very interesting tests on the
Efficiency of Dynamo
Electric Machines is described
In these tests the Siemens
Machine is set down as returning
~~to~~ giving to the circuit
90 per cent of the power
applied to the shaft.
I desire to call ~~the~~ attention
to the fact that the writer
has assumed the EMF of

1. 44%.
Houston Thompson
1.079

a Daniel Cell to be $\frac{9}{5}$ of
a volt, from which he
Calculates the Energy in
Current, while the value of
the horse power ~~output~~ should be Calculated
from a Daniel Cell having
an Emf of 1.08 Thus
This is as it is given by
Clerk Maxwell, and by Kohlrausch
at 109 —
taking the Daniel Element
at the Correct Emf. This would
make the Efficiency of
the Siemens machine
—— worked off ——
again 0.28 of a horse power seems
to be a large amount to run
the Gulcher without an open current,

again he uses a Calorimeter which he states to have a reputation of about [illegible]

It seems impossible from the number of experiments that the Calorimeter described & used, could have given correct results, such as the apparatus is directed to [illegible] owing to the small amount of fuel and Barometric Correction [illegible] this introduces [illegible] the error of unequal temperature between the Condenser & flue & he says a variation of 2° in favour of the higher Efficiency of the machine

If this is over estimated the Efficiency of the machine is still further reduced, H

Mr H's paper is of great value as the only test yet made on it is directed in a truely scientific manner and, I have no other object in calling attention to these, more difficult than that the true Efficiency of the machine should be ascertained in order that any one who may hereafter produce better results shall not have the paper and figures for the same; fictitious Efficiency quoted against him

To the
Editor of Engineering!

Sir.

In your journal of May 9. 1879, contains a paper by Dr. John Hopkinson F.R.S. M. Inst. M.E., giving some very interesting ~~and important~~ results of tests of a Siemens machine. These tests show that to make the machine convert 90% of the power given it into electricity

By these tests the machine appears to convert 90% of the energy delivered by the belt, into electricity

The power is delivered through a dynamometer and

The method pursued is as follows, the power absorbed is measured by means of dynamometer, and the energy of the current by calculating the electromotive force and a given resistance is calculated from measurements giving the electromotive force on a given resistance and the total resistance of the circuit, or from a measurement of the heat given off on the entire resistance or a part of the circuit by means of a calorimeter.

1 ft
100 ft

1/10 in
1/100

.03302
.03302
.03302
.05115
.98187
2
.96374
.9242
90
.831780

3/10 X12
3.6 inches
100 ft 1/100
3 X100
36 inches

I would call attention to the fact that the writer has assumed the E.M.F. of a Daniells as 1 & as 1.125 Volts. ~~Latimer Clark~~
The value taken by Messrs. Houston & Thompson is the same as that given by Mr. Latimer Clark on the authority of Prof. Ayrton. 1.079 Volts. as the energy is as the square of the no. of Volts, to compare the results given with those of the Franklin Institute they must be multiplied by $\left(\frac{1.079}{1.125}\right)^2 = .919 \quad .9242$. give The machine would be on this basis 83% of the energy back instead

Ohm too great
1.0196 absolute

There is as yet no reason why the German measurements should be taken and if for if they are considered correct the value of the Ohm must be changed to correspond.

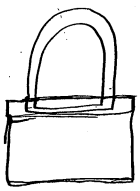
If the value 7/8 of the equivalent of a Daniells by some tests made on the new machine of Mr. Edison would give more than 100% of the power applied into electricity, and of this 7/8 may be made effective outside of the machine when the machine is consuming five H.P.

of 90%

If the German values ~~as given in Wiedemann~~ are ~~true~~

If Dr. S. Hutchinson's tests ~~Weber's determinations as given in Wiedemann Bands II. Part Vol. IV, section 1044, has stated~~ ~~between a standard of~~ ~~and 1.0000~~, ~~the Ohm should be~~ ~~by 1.0196 to~~ ~~said to substitute mean~~ ~~as determined by Weber.~~

Ohm The Daniells cell used was the gravity form, which has the E.M.F. of which is my best ~~1.1336~~ ~~more than~~ ~~less than the~~ standard Daniells with pure cup and concentrated solutions ~~thoroughly saturated~~ such as is described by Wiedemann.



5510 3.7412
44.3 1.6464
5.3876

244200

7.70 .8865
4.5185
5.4050

254000
5.3876
5.4058
.1722

93%

so that it seems strange to read in one place that the resistance was about 1/5 and in another that the resistance of the connecting wires was estimated at .01 ohm. When giving off [illegible] as in Ex. no. 12

I would also call attention to the fact that in measuring the heat by means of a calorimeter, a variation in the calorimeter, in the resistance of the wire, as given as above .2 of an ohm. A very slight error in the measurement of this would be greatly multiplied in the total. No allowance seems to be made for the fact that the wire must necessarily be much warmer than the water (in which it is immersed) and that its resistance would be increased by that much, thus making the machine show a greater efficiency than it ought to. For having a large res

T.S

It seems very important that some standard should be adopted for E. M. F. and as yet there is no good ground for taking other determinations than that of the British association. If those of Weber are employed corrections must be made for the fact that the ohm is not a perfect according to his measurements.

If the volume 1.125 Volts for a Daniells be employed in testing, a new machine of Mr Edison's shows that more power is given off as electricity

$$\frac{w_2 w_3 - w_1 w_4}{(w_1 + w_2)(w_2 + w_4) + w(w_1 + w_2 + w_3 + w_4)}$$

$w_1 = 10$

$w_2 = 1000$ 1000.5

$w_4 = 5$ 15

$w_3 = .052$ 16

~~$\frac{5000 - .8}{15000 + 2(1015)}$~~ $w_3 = 6$

~~$\frac{6000 - 5+}{16000 + 5(1016)}$~~

~~$\frac{5000}{16000} = \frac{5000}{17000}$~~ 4

Air is delivered to the machine.

$w_3 = 40$

$$\frac{52 - 50}{10006 + 1015} = \frac{2}{11021}$$

$w_4 = 6$

$$\frac{52 - 60}{10006 + 1016} = \frac{-8}{11022}$$

64

7.70

3 sec.

254000	5.4050
5.777	3.7612
	1.6438

44

7.70	0.8865
33000	4.5185
	5.4050

5.777

3.19	.5038
32.000	4.5185
	5.0223
2372.	3.3786
44.3	1.6437

In experiment No. 12

65

5.349	3.7284
44	1.6435
6	5.3719
235,600 .677	.8274
	4.5445

2 (1.345 / .677

35,010 ft lbs at least

35,000 ft. lbs. of energy given off from a wire 2 metres long and 1.5 mm in thickness.

2. .0015

.0015 3.14

.003

.00942 D m

94.2 □ centimetres surface

1.5⁻⁹ ,2014
33.000 4-5.185
4.7199
1179 3.0716
4.6483
0682
34
.0716 44.5

.168 ,2253
33.000 4,5-185
~~1.7068~~
4.7438
1263 3,10 15
43.9 1,6423

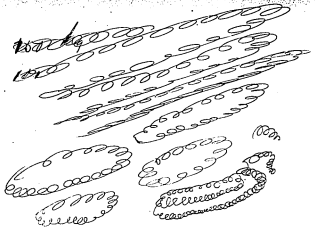
2.81 .4487
3,14 4,5-185
4.9672
0d 942 3,3234
2106 1.6438
44.0/5
.0020

cm = .392 in T .5933
T .5933
□cm = □in .153 T .1866

.153
94.21.9721
1.1587

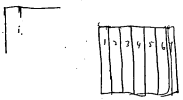
14.5
~~15.15~~ sq inches.

That is the heat of a large gas jet is given off from a surface of about 15 square inches. Ordinary experience would suggest to us that the metal must be considerably heated ~~for~~ ~~a~~ ~~small~~ ~~fraction~~ ~~of~~ ~~an~~ ~~inch~~ ~~or~~ ~~a~~ ~~couple~~ ~~of~~ ~~inches~~ ~~of~~ ~~the~~ ~~surface~~ ~~before~~ ~~boiling~~ ~~points~~.



1/8

Tried an experiment. A piece of German silver wire about a mm in diameter was immersed in water and a strong current passed through it.



76
14.5

If the metal was heated to boiling 170° ~~from the~~ ~~point~~ an error of about 2 0/0 would be introduced

It does not seem unreasonable to suppose as long as the heat was evolved from the middle of the wire that there may have been an average rise of 500° in the wire

1.00024
500
1.12000

That is a ~~rise~~ an increase of 12% in the resistance of the wire

1.5 mms
3.14
1.5
1570
314
4.710

.00471 m.
2
2 m. .00942 □ m.
.00942 m
.942 dm
94.2 □ centim.
94 □ Cm

5349 3.7284
5777 3.7618

In these 12 according .9666 to the ruling
the calculation

92% of the power given to the machines is converted into electricity. In the remarks the fact is mentioned that the belts were slipping. As any slip of belts would consume power in heating the ~~bearings~~ pulleys and belts a deduction would have to be made from the power indicated, so that 92% is probably much within the real per cent as read from the calculation

1.079 × 1.125 = 1.9819

.0330 + .0511 = .1841

95
90
92
90
9.80

.92 × .12 = 184 + 92 = .1104 → 81%

If 12% is deducted from the reading of the calorimeter only 81% of the power applied is given back as electricity

1.140 × 1.179 = .9887

.0569 + .0682 = .1251

97.4%

21.08 − 21.06 = .0108

.3340 − .3234 = .0106

2.903

102%

2.888 .4608
2.780 .1440
.0068

104%

2.903 .4629
3.538 .5474
.9155

82.3%

92 %

The per cent of energy interned in the shape of electricity from the calorimeter tests is in Ex

Ex. 4	97%
Ex. 6	102%
Ex. 8	164%
Ex. 10	82%
Ex. 12	92%

Two experiments out of the five showing more power

tests given and
The articles is by far the best
that have yet been published,
in that all the particulars under
which they were made are
stated, and the reader may ask
questions in the same manner
as if the apparatus were
before us.

~~And in this particular the~~
~~paper is by far the best one~~
~~that have yet appeared~~

in the circuit than in 77
The given to the machines.
and one is 15% from
the mean of the other four,
and one is practically worthless
on account of the slipping of the belts,
while all have a constant
error.

I cannot leave the paper
with only adverse criticism, for
criticism in itself is praise
of the fullness with which
the results are described. As a
reader I have found that I
can push in complete possession
of the facts for I have not
been able to ask any questions
that I have found unanswered
a paper of ~~last~~ this

decides having all the experiments of this ~~the~~ writer.

same accounts better than ~~a~~ kind is assigned as a series of experiments ~~performed by~~ made personally, for one can often see sources of error far clearer in watching another's work than in his own,

Yours Truly
Francis R. Upton.

Menlo Park N.J.
July 7, 1879.

80 1

28 AWG #48 1

The [illegible] of [illegible] -
[illegible] by [illegible]
[illegible] 28 AWG [illegible]
[illegible] turning the bobbin
[illegible]

100 Volts

25	1.3979
25	1.3979
4	0.6021
44.3	1.6469
	5.0448

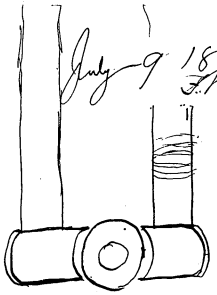
110 000

5 ohms 150

30 900
30 5
45 00 3.16532
44.3 1.6469
5.2996

199000

July 9 1879.



Trowbridge's article J. C.
Phil. Journal Vol 7 No. 42

In the galvanometer method he does not mention the fact that and takes for granted that a galvanometer of low resistance must be used in order to shunt of extremely low resistance. Though the method is faulty on account of the heating of the shunt, still it is applicable under the form of an electrometer method by using very high resistances. He speaks of the difficulty of measuring resistance by means of the galvanometer on account

of changes in the thermometer? In the electro dynamometer method he determines the constant by the aid of the instrument. This can only be used when the instrument is placed on a stone pier and [illegible] firm.

He speaks of the dynamometer being useful only for medium powers from [illegible] to very large ones, small ones the indications having very little value.

His estimates were made with the machines on almost closed circuit, and he mentions that the belt slip

8 30000
031
32000
99
1022.ans

206
33
618
618
6798

3265
33
984
984
10824

so much as to [illegible] recordings render this reading somewhat uncertain TOK

Estimates power required

from the armature of the Siemens on open circuit as 0.031 H.P
1022 ft lbs.
and the Gramme from 0.206
to 0.326 H.P.
6798 ft lbs to 10,824

How this limits are measured so exactly when there 40% difference between the extremes is hard to understand.

Hi speaks of the "equivalent of a Weber" as 102 metre-grams

102 / 136 × 60

23) 1020 (44.33
92
100
92
80
49
110

235 .3711 168 .2253
365 .5441 283 .4518
.8270 .7735

67 .336 .5263
45.3 .6561
.8102

163 .2122 309 .4450
298 .4782 553 .7967
.7380 .7417

254 .4048
644 .8089
.5959

That means that work done by a Weber in passing over an Ohm is 102 M-S- in a second or 44.33 ft. lbs. in a minute.

Wilde machine

Magneto run by a wire apparatus wire about the armature. The result was that when the machine was running on short circuit it absorbed less power. Reason, apparently when a strong current is passing, it changes the pole of the armature so as to [illegible] work it around about the magneto

62.33 | 1.7947
.594 | $\bar{1}$.7738
3702 | 1.5685

9830

.857 | $\bar{1}$.9330
43.82 | 1.6415
1.5745

.907 | $\bar{1}$.9576
60.25 | 1.7799
1.7375

1.039 | 0.0168
39.28 | 1.5941
1.6109

1.453 | $\bar{1}$.1623
44.94 | 1.6526
1.8149

328
2.3
984
656
7.544

7 lbs. of wire on armature for magnets.

TCG

21 lbs for the alternating arm - ments of the circuit.

The electromotive force varied greatly according to Trowbridge.

In circuit		E.M.F.	Speed	Speed reduced
.594	Ohms	37 Volts	548	67
.857		37.5	532	59
.907		54.6	500	74
1.039		40.8	520	55
1.453		65.3	520	56
2.305		75.4	528	39

If the current is a to and fro or alternating, it would seem absurd to speak of the number of Webers, [illegible] this energy [illegible] given to the [illegible]

~~rate change their~~ 166

If the currents change their direction they are constantly rising and falling so that there can be said to be no definite current on the line. Then as the dynamometer reads the square average of the squares of the currents, it cannot be without extreme accuracy of expression be said to measure the currents, for nothing is known as to the current strength. The mean equivalent should be introduced.

A ½ shunt of 0.1 Ohm was used in these measurements

2.7275 2.7832
2.1399 2.1399
48674 41.9231

675
341
334

.675 1.8293
86 1.9345
1.7638

760
341
419

.766 1.8842
75.6 1.8785
1.7627

781
341
440

.781 1.8927
75.6 1.8785
1.7712

509 .7067
589 .7701
.9366

442 1.6454
534 .7275
.9181

455 .6580
607 .7832
8748

81.300

.138
2.7701
2.1399
49100

Gramme machine (large size)

483 lbs of wire on magnets

Armature	0.129
Magnet	0.212
Total	0.341

Ohms	Circuit	Volts	% efficiency	
0.334 ohms	0.675 ohms	58	86.0 %	1
0.419	0.760	58	82.8	2
0.440	0.781	60.5	75	3

No 1 Mean
432 81.300 ft lbs commutation
2 466 73.600
2 452 83.800

The appearation of armature is here found, ~~in giving 6 figures~~ as 6 figures are given in the results of the horse power where two figures are probably not correct

2 on No. 2 with 0.760 Ohms

607 .7825
534 .7275
.0550

in the circuit 534.336 metre grammes running at 462 revs., while in no. 3 when running at a slower speed and having a greater resistance in the field 607.200 metre-grammes are consumed or nearly 14% more power where at least 2% less should have been taken, showing that in this case not even one figure was right.

100

.1973	1.9887	8312 .9196
79.8	1.9020	138² .1399
	1.8901	5.0395
1.055	0.6223	
68.8	1.8376	744 .8716
	1.8619	.1399
		5.0115
1.066	1.0283	839 .9238
66.	1.8195	.1399
	1.8478	1.0637

632	.8007	580	.7076
831	.9196	744	.8716
	.8811		.8360

472	.6739
839	.9228
	.7501

101

Siemens machine (Many exp.)

Wire carried around the [illegible] from armature. Eight divisions in the commutator

Resistance machine 0.5-86 Ohms

Speed at which it ought to run 370 - 380. Speeds in tests 264 — 325.

Resistance of circuit	Volts	~~Volts~~ unwrapped	
.973	77.5	109.000	1
1.055	72.7	102.000	2
1.066	70.4	110.000	3

	%
1.	
2	76.
3	68.5
	56.2

This seems to be an almost impossible result ~~for~~ for such slight changes in the speeds to make

such great changes in the 103
percent of power utilized.

A.

536	2.72792	536	2.72792
1076	3.0315	896	2.95523
	.6977		1.8769
454	2.6571	454	2.6571
1177	3.0710	1053	3.02254
	1.5861		1.6346
583	2.7657	583	2.7657
1242	3.0934	1092	3.0383
	.6723		.7274
376	2.5752	376	2.5752
970	2.98648	892	2.9504
	.2884		.6248
389	2.5899	389	2.5899
1285	3.1089	1175	3.0701
	.4810		.5198
438	2.6415	434	2.6375
609	2.7846	565	2.7520
	.8569		.8855

Houston & Thompson

per cent converted of power

	including friction	excluding friction
Large Brush	49.8	55.3 %
Small Brush	38	43.1
" "	47	53.4
Small Wallace	38.8	42.1
"	30.3	33.1
Thomson	71.9	76.8

Edison	90	94

A lt of coal an hour for
H.P

12000 # coal
1980 evap

38.000
60
1980,000

1200
198

1/6 of total energy utilized

Boyle Higgs p 175

1 cubic foot coal gas = 690
heat units when burned

772 2.8876
690 2.8388
5.7264
5.31000 ft lbs
5
2655,000 ft. lbs. for a gas
burner in an hour

2655 3.4073
1980 3.2967
.1106

129 H.P. evap is the
equivalent of a gas flame

1.29 at ex lights per
6 horse power
7.56

7.5 lights by means of
Rt from the same energy
as is used in a gas burner.

Franklin Institute

380 candles for H.P

15) 380 (25 gas jets
30
80
75
5

1 lbs gas coal produces
4 cubic feet of gas

12,000,000
2,112 4,000

5 31,000
2,112 4,000 ft. lbs

about 1/6 of the energy in
the coal in the gas.

In lb of gas coal there are 15000 units of heat

772
15000
3860
772
11,580 000 ft. lbs.

In coke 13.000 units of heat per lb
772
13 000
2316
772
10,03 6000 ft. lbs

Gas tar 20,000 units of heat in a lb
772
2
15,440,000 ft. lbs.

10,036,000
.85
50180
80288
8530600.00

15,440,000
.05
772000.00

1 lb of coal produces
4 cubic feet of gas
.85 lb. coke
0.05 tar

F. G

Coal 11,580,000 lbs. Gas 2,124,000
Coke 8,530,600
Tar 772,000
11,426,600 lbs.

Profit Loss 11,580,000
11,426,000
154,000 lbs.

3080 | 41165
14 | 11461
2.9704
365 | 2.5623
.4081 2.56 hours per day
24 hours a day

24 | 2.55
1

275
5
1375 | 3.1383
14 | 1.1461
1.9922

$98 capital a light

63
4
252

1760
150 jets

Estimate of Edison light July 10 1879

54
20
1080
10
1090
2
2180
1090
3080 pence per year
14

542 10s per year
for 14 lights

Paget Higgs estimates that the amount to be invested for a light Canopy by the Edison system as $98. 20 candle power 7 per H.P.

Estimate of the cost of working E.L. from a small power.

Boyet Higgs

£ 12/5 for full 2 H.P

$ # 60

60. 1,17782

365. 2.56223

9.21 99

16.14 d/c :: day

8.4 cts per day per H.P

3/4 ct for fuel per H.P

£ 15/5 oil & attendance

$ 75 1.87501

2.56223

9.3128 20.5 cts per day

10.5 per H.P

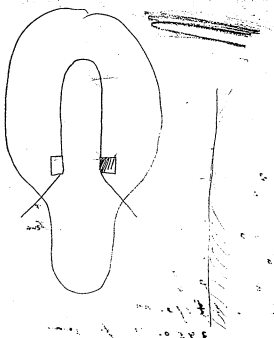
.5/6 ct per hour

10.5

8.4

18.9 cts per day of 12 hour

1½ cts per hour per H.P



In a ~~article~~ read before
Lecture delivered by Prof. W. E. Ayrton.
on "Electricity as a Motive Power"
I find the following facts as to
cost of power

In Sheffield.

~~£125~~ @ 500,000 tons of coal used for [illegible]
300 @ 750,000 " for melting
metals &c per year
~~£200~~ @ 150,000 " for heating gas
258 @ 250,000
1.650,000

Cost about £790.000
£3.950.000 per year

300
11
303
1800
183030 - 10 hours - day

17
3
61

Niagara Falls

100,000,000 tons in an hour
falls 150 feet
= 17,000,000 H.P.

Steam engine 3 lbs of coal per hour per H.P.

200,000,000 tons of coal a year equal to total consumption of coal for the world

Ayston

Best steam engine
2½, 3 lbs. of coal an hour
considerably less than a farthing
expense. One horse power
cost about 2d in a large
quantity, one single H.P. ¼.
na

Water motors.
1 cu. ft. 62½ lbs
½ descending 1 ft per minute gives approx.
1 foot lbs of work per second
That is 5½ cu. feet of water per minute
330 " " per hour
with 100 feet of head gives one
H.P. as practically a turbine gives
6.8 took we may say
450 cu. ft. of H_2O per hour
2700 gallons
produces 1 H.P.

Price in Sheffield

6d per 1000 cu ft

Cost of H.P. 1/4d per hour

1 shilling 4 pence

32 cts for H.P. per hour

52 gas jets 9 candles each

9

468 candles 2½ H.P.

2.5 0.3979

33.000 4.5185

comp 468 7.3297

176 2.2461

4 33.000 4.5185

380 2.5798

19387 86 ft. lbs per candle

5600 Arangappani

Frang

Cost of E. L. Northern R.R. of France

see page 189.

176 foot lbs for a candle

former number expended. was

away 1/3 in use

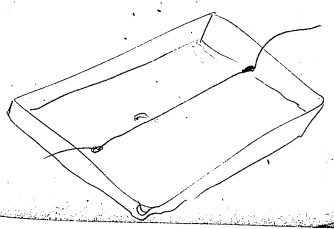
5.9 ft lbs Say

60 ft. lbs. per candle in use

Franklin Institute

ft. lbs per candle

in H. P. expended



Oct 13 1879

Holly Company will furnish a horse power for $90 and guarantee 2 lbs. of coal with a condensing engine. Boilers $18

Table

1 hour per day	365 hours per year
2	730
3	1095
4	1460
5	1825
6	2190
7	2555
8	2920

TOS

300 2.4771
2240 3.3502
1.1269
1.33

Coal $3 per 2240 lbs
1.33 mills per lb.
2
2.66 mills 2.66 cts. per hour

Compare the Hulby at $90
with an engine using 4 lbs.
of coal at $2.5 per horse hour

TUS

365 2.5623
266 1.4249
1.9872 97.7 cts

	1 lbs per hour	
1	$.485	$4.85
2	.971	9.71
3	1.456	14.56
4	1.941	19.41
5	2.426	24.26
6	2.911	29.11
7	3.196	31.96
8	3.681	36.81
10	4.850	48.50
16	7.76	77.69

Table cost of coal $8.00 per 2240 lb 133

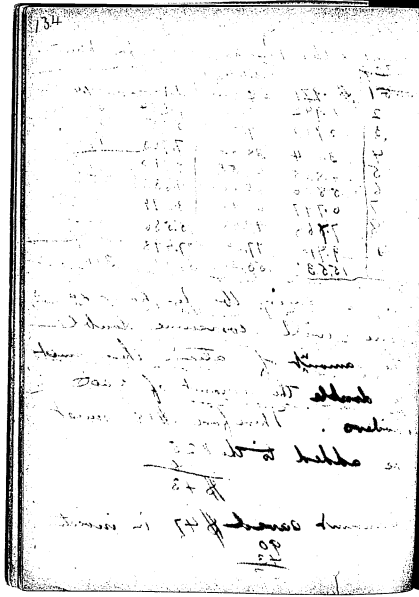
hours used	2 lbs per hour	2 lbs per hour capitalized	4 lbs per hours
~~365~~ 1	$.971	$9.71	1.942 19.42
2	1.942	19.42	3.884 38.84
3	2.913	29.13	5.826 58.26
4	3.884	38.84	7.768 77.68
5	4.855	48.55	9.710 97.10
6	5.826	58.26	11.632 116.32
7	6.797	67.97	13.574 135.74
8	7.768	77.68	15.556 165.56
10	9.71	97.10	17.498 174.98
16	15.53	155.30	31.11 311.10

As a four lb per hour engine will consume double the amount of steam there must be double the amount of ~~feed~~ boilers. Therefore $18 must be added to the $25

18
$43

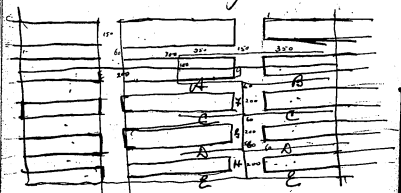
Amount saved $47 in investment

90
43
47



As two lbs. of coal per hour would be saved the minimum would occur when the capital to be invested equalled the amount to be saved that is at about five hours per day.

When the engine is used more than five hours a day $90 per H.P would be economised less than five hours $25. per horse power would be economical



180
900
750
15-30
60
200
179.0

40 ½ Half Block
220
240
60
102.0 Common

1020 by 10 ft
To 200 Lots

in block to Rabin

Holly estimate 1 square mile of city.

~~30 feet~~

Blocks in N.Y. 700 feet long
200 feet wide

24 lots on cross streets Hew city.
8 lots on avenues
Practice 30 on cross street
10 on avenue

80 houses in block

60 feet street

A	80 houses	250 feet	23 lb	0.123		
B	80 " "	810	1620	246 —	—	.393
C	80 " "	1070	2140	8586 —	—	1.038
D	80 " "	1330	2660	13260 —	—	1.293
E	80 " "	1590	3190	9480 —	—	.747
F	20 " "	1870	1000	620		.162
G	20 " "	600	1500	1088		.246
H	20 " "	760	2040	2694		.326
I	10 " "	1020	610	200		.065
		1400		361 0/4		4393/4
				144.404		17392

143

30 Lbs

7812
3
23446

1820

82.00
3 lbs
246.00

60 1070 2 2140

143 60 85.80

D 2660

E 221 60 13260

1520 2 3180

316 30 9480

760 2 1320 1302 20 2604 0

544 2 1088

900

2240 2660 20 4900 245 20 294

Use 2 cans

6 tons of coke

143

A	lbs 23		
B	246		
C	8580	10 days 12	
D	13260		
E	9480	365	
F	620		
G	1088	10.00	
H	2604		
J	200		

290 | 3 61 01 (1 5 1)

290 | 36101 | 124
290
710
540
1700

124 lbs per house

30
3720 per house at 3 o cts

Cost much more?

per house

per Camp &

per Camp & Conductors &

144

$5.00 $5.00
$5.00 $5.00
$5.00 $5.00
$5.00 $5.00
$5.00 $5.00 $5.00

5 1000 hours a year
5000 feet
$5.00 a year from a lamp

Average use Summer
7.30 — 10 — 2½ hours
5-00 — 10 — 5 hours
7½ 3.21
5½

$10.00
$2.00 per 1000 feet for capital
1/10 H.P.

145

1200 ohm lamps
10 per H.P.

$45 $4.5 $100
100

709

each street 950 feet 950
5
4750
1900
6650
4
26600
3200
29800
3200
33000 feet of trees on both sides of street

Avenue 800
4
3200

65
16
390
65
1010

$7000

$20

$20

$20

$20

$20

$20

$20

$20

$20

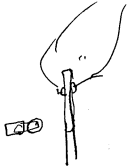
$20

$20

$20

$20

$20



148 May 8 1880

Winding machines

Present machine
110 Volts

~~Whittakers reservoir~~
~~Whittakers~~ Whittaker

Let x = resistance machine
y = E.M.F
C = no. coils
F = ~~length~~ Diameter of armature
L = Length of armature

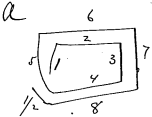
$y = C \times F \times L$

$x = \frac{C \times F \times L \times \text{Resistance wire}}{y}$

149

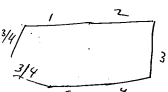
Two machines put together

A



8.5 = length

B



6.5 = length

A |:::| six wires

B |:::| twelve wires for first 1/2 the resistance

A .14 Ohm

B $\frac{.14 \times 6.5}{8.5 \times 2} = .046$ Ohm

17)77 (4.5
68
90

.045

$\frac{11}{34}$ of the natural resistance

1/3 the resistance

TUE

Present Armature

10 X 10

Surface

End 78.5

78.

314

470 sq in.

8 1/2 10 inch length.

85 inches of wire in loop

the wire is made up of six strands

.042 in cross section .001385 sq in

.011 covering 3

.053 Total 4155

.002206 sq in

3 wires 3

Solid .053 3 .053 3 .159 .159 1.48 1.5

.053 .053 .159 265 .00280 9 .00842 7

3 pcs 3 wires .008427 sq in.

.004155 sq in. Cu.

.004272

If square 5 2 9 6

.006216

20 inch = diameter

10 inches = length

Surface

314 78 1/2 312

2 312

628 312

628

125.2 sq in.

125.2

1252 3.0976

470 2.6721

.4255

2.6 times the surface

If the wire is square with .011 in covering

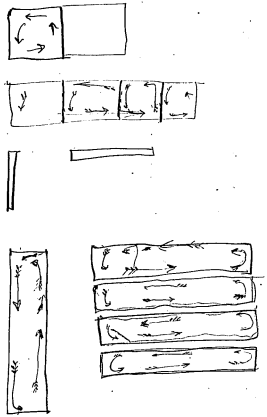
.006216 sq. in Cu may be put in the space

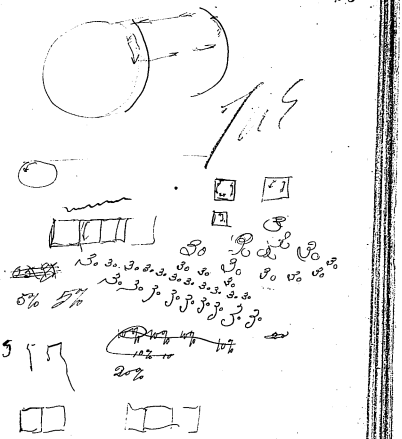
.006216 / .004155 = 1.5

.006216 / 4155 / 20610

.666 = 1/1.5

.66 .009 .00594





.20 inch armature
60 inches long.

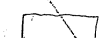
Wire 62.8 inches circumm.
39 commutators

62.8 1.7880
78 1.8921
T.9059

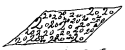
.80.5 in to coil Total
.055 for insulation
.750 cu. inch

.053
8
.424 .400 thick

750
400
.300000 sq in.



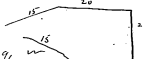
20



12) 3549 (295
24
1 18
109
96
13
74 feet

1.9X inches
39
819
273
12 354 9 inches
12
29 feet
72 feet

.3 sq. in.
section



.000000 854 sq in

Comp .300000 7854 6 8552
72 85773
993 930 99600
9.2263

log 9.936 — 0.9971
1000000 7854 — 1.8951
log .72 — 1.8573
comp .8 — 0.8229
3.2724

.00187 Ohms resistance of machine

00187

57
.159

120
960 | 1000

1000
960

1000

3.
2.9823
+.0177

20 | 1.404 Ohms
.0054

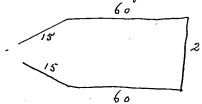
.00/0
.0005
.1
.005

.00187 | .000
.00187

160

Machine

6 magneto



30
60
60
21
171 inches around the armature or length of one coil.

12/171 (14.25 feet length of one coil
12
51
48
30
27
60

14.25	1.1538
39.	1.5911
2.7	8449

555.7 feet of wire

164

.3 sq. in. cross section.

Ohms	10.64
	.0000007854
log	555.7
Comp.	.3
	2.9888

1.0269	
7.8951	
2.7449	
10.5229	

~~4 | .009145~~ ~~.002436~~
4 | .01548
.00387

Resistance of machine ~~.002436~~ .00387 Ohms

Resistance 1000 lamps

.1 Ohm

$\frac{.1}{20} = .005$

$\frac{.1}{40} = .0025$

~~Do 40:1~~

comp	.1	1
	.00387	2.4123
		1.4123

25 : 1

Resistance 555.7 feet = ~~.009745~~ Ohms
= .01548

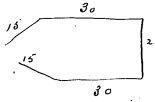
Resistance 1 ft. ~~.01548~~

$\bar{2}.1888$
2.7449
$\bar{5}.4439$

.0000278 Ohms

2.5 feet $\bar{5}.4439$
0.3979
$\bar{5}.8418$

~~.00695~~ Ohms
.000695



30
30
30
21
12/111 inches
9.258 feet around the armature

9.258
14.25

.009745 $\bar{3}.9888$
~~9.258~~ ~~1.9664~~
~~555.7~~ ~~7.2551~~
~~$\bar{3}$.2103~~

.009745 $\bar{2}.9888$
9.258 0.9664
14.25 8.8462
~~4|.00633~~ $\bar{2}.8014$
~~.0015825~~

resistance of the machine

4|.01003
.00251

Resistance 2.5 feet or 30 inches

.000695 ohms
X 4
.000278

$\bar{5}.78418$
0.60211
$\bar{4}.44439$

10 inches radius
10.45

1.
1.0191
1.9809

If 3 Volts ~~are~~ is the average E.M.F. then the is active between outside and inside of wire

3. $\bar{1}.4771$
$\bar{1}.9809$
0.4580

.45
10.45

$\bar{1}.6532$
1.0191

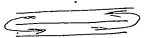
3.
.105

$\bar{2}.5441$
0.4771
$\bar{1}.0212$
$\bar{2}.0424$

$\bar{2}.0424$
1.6464
$\bar{1}.6888$ .488 ft lbs
Comp .00278
$\bar{3}.6561$
$\bar{3}.2449$ .000695 lbs

2.5 feet of wire ~~.002778~~

If it is assumed that the current, has to travel around the wire

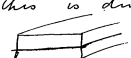


the resistance will be ~~twice~~ this four times this $\frac{.00278}{4} = .00278$

1760 3.2449
78 1.8921
5.1370

137,000 ft lbs.

If this is divided length-ways



in each half there will be 1/2 the E.M.F and twice the ~~resistance~~

or 1/8 of the power lost

8 ⟌ 137.000
17.125 ft lbs in each
2
34250 " " total

The there will be active on the whole $\frac{105}{2} = 105.2$ Volts on a resistance of

9.25	.9661
.0000278	$\bar{5}.4440$
.000257	$\bar{4}.4101$
4	0.6021
.00103	$\bar{3}.0122$
.052	$\bar{2}.7160$
	$\bar{2}.7160$
	1.6464
	2.9878
117 ft. lbs.	2.0662
39	1.5911
4500 ft. lbs.	3.6573

34,250
4.500
38.750

If again divided it would require 1/4 of this amount

4 ⟌ 38.750
9.687 ft lbs

10.000 ft lbs lost by local action, with four wires

Present machine

.042

10.042

10.42 1.0178

comp. .042. 18.3768

18.3768

3.7714

1 ft of wire .00591 Ohms

9.258 feet around the armature

48 wires

$\mathcal{E}$ = E.M.F. driving

$\mathcal{E}'$ = " " receiver

R = resistance circuit

$c = \frac{\mathcal{E} - \mathcal{E}'}{R}$

Work = $c(\mathcal{E} - \mathcal{E}')$

$= \frac{(\mathcal{E} - \mathcal{E}')^2}{R} = \frac{\mathcal{E}^2 - 2\mathcal{E}\mathcal{E}' + \mathcal{E}'^2}{R}$

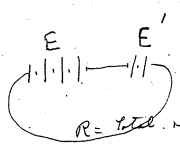
Work on resistance $= c^2 R$

$= \left(\frac{\mathcal{E} - \mathcal{E}'}{R}\right)^2 R$

$= \mathcal{E}$

1/4 the resistance

1/2 the E.M.F.



R = Total resistance

$c = \frac{\mathcal{E} - \mathcal{E}'}{R}$

$c = \frac{\mathcal{E} - \mathcal{E}'}{R}$

$c\mathcal{E}'$ = Work on ~~the~~ battery $\mathcal{E}'$

$c^2 R$ = work on resistance

$$\frac{\mathcal{E}'(\mathcal{E} - \mathcal{E}')}{R} + \frac{(\mathcal{E} - \mathcal{E}')^2}{R}$$

$$= \frac{\mathcal{E}\mathcal{E}' - \mathcal{E}'^2 + \mathcal{E}^2 - \mathcal{E}\mathcal{E}' - \mathcal{E}'^2 + \mathcal{E}\mathcal{E}'}{R}$$

$$= \frac{\mathcal{E}^2 - \mathcal{E}\mathcal{E}'}{R} = \frac{\mathcal{E}(\mathcal{E} - \mathcal{E}')}{R}$$

44) 200 (4.5
176
240

4.5 smaller for Cu Pt
but larger for Zn

3 smaller for Cu Pt
Brass

Total work = $\mathcal{E}c$

$c\mathcal{E}'$ = work useful

$c(\mathcal{E} - \mathcal{E}')$ = work on resistance

Distribution of work

$\mathcal{E}'$ to $\mathcal{E} - \mathcal{E}'$

THE

25 volts
25

25	1.3979	
25	1.3979	
44.3	1.6464	
		4.4422

27700
11080 00

$$\frac{d\,\frac{\mathcal{E}\mathcal{E}' - \mathcal{E}'^2}{R}}{d\,\mathcal{E}'} = \frac{\mathcal{E} - 2\mathcal{E}'}{R}$$

$\mathcal{E} - 2\mathcal{E}' = 0$

$\mathcal{E} = 2\mathcal{E}'$ maximum

3 magnets

.00591	3.7714
9.258	.9665
39	1.5911.
comp 4	9.3979
	1.7269
comp 48	8.3188
	2.0457

.0111 Ohm if wound with wire four wire deep.

.00555 Ohm if wound 8 wires deep

120 H.P. in the current 8 lamps per H.P.

960 lamps 2

7.0176

Resistance multiple are 1.0176

.1041 Ohms

Conductors .0104

20) .1145

.00572 resistance of machine 20 : 1

Heat on machine

Surface of present machine page 152 470 sq in from this can be taken 75 Lamps about 85 Ohms each for two hours

85 1.9294
75 1.8751
.0543

1.133 Ohms multiple arc
.113
1.246

reactance of machine
.14 Ohms

1.246 .0955
.14 1.1461
.9494

8.9 : 1 ratio total outside

.0543
1.1461
.9082

8.1 : 1 ratio Camps

75 Camps 8 per H.P

75 1.8751 ∠
8 .1031 ∠
9.37 H.P .9720 ∠
.9082 ∠

Machines .0638 ∠
1,115 H.P 4.5185 ∠
33000 4.5823

38.200 ft lbs from armature

4.5823
4.70 2.6721
75 Camps 1.9102

81.3 ft. lbs. per sq in.

60 Camps

3600 3.5563
cond 5625 6.2499
81.3 1.9101
52 ft lbs 1.7163

page 176 20 inch

Surface 20 in X 30 in

Ends	314.
	314
62	1860
30	2488 sq in
1860	

Multiplaces R .1041	T.0176
.005555	3.7443
18.7 watts	1.2733
H.P 120.	2.0792
	1.2733
6.4	.8059
Comp 2488	4.5185
	6.6047 1.1226
	1.9285

84.8 ft lbs per sq. in.

Recapitulation 10X10 armature

surface 470 sq. in. to 1.5 H.P.

When taking 75 lamps from this surface about 85 Ohms and 8 per H.P. in current

81.3 ft. lbs given off from each sq. in of armature.

20X30 inches armature

surface 2488 sq. in

wound with 8 deeps of .045 in. wires Resistance .005555 Ohms.

120 H.P in current gives 84.8 ft lbs per sq. inch of surface

That is if a machine can be built which shall give the E.M.F required.

280 lbs. bar back
700
280
1260
3 magnets
3780 lbs

20 in
3.14
20
6.28
78
.805

1.7980
1.8921
1-9059

12 wires

.048
6
.054 wire
12
108
54
.648

.048
.011
.059 wire
12
118
59
.708

.042 $\bar{2}$.6232
.042 $\bar{2}$.6232
3.14 0.4969
96 1.9823
$\bar{1}$.7225
.6021
4 .133 $\bar{1}$.1235

There is .805 in sphere
for winding 20 inch armature

.048 wire
6 coverings
.054 fills .648 in

39

.048 .059
8
.472

3/472
19.66
4
78.64
11
67.64

78.64 - 4858
67.64 3593
54
14372
1796.5
.194022

.048 1810 wires
96
10860
162900
17376.0
.048 wire

.642 wire .133

Gross section .468 wire

144.173 :: .00555

2.7443
3.2380
7.7122
3.6945

.00496 Ohms

1.0176
3.6945
1.3231 21.11 Ratio

2.0792
1.3231
.7561 .5 H.P
1.1226
1.8787 75.6 ft lbs per sq in

117 wire

10751
24
43004
21502
258024

258.173 :: .00555

2.2380
3.7443
7.5884
3.5707 .00377 Ohms

1.0176
3.5707
1.4469 2811 Ratio

2.0792
1.4469
.6323 4.3 H.P
1.1226
1.7549 56.8 ft lbs per sq in.

Wind with No. 11 wire

.120 24 strands to

Commutator

120
6
.720

Resistance 0

.109	$\bar{1}$.0374
.109	$\bar{1}$.0374
3.142	0.4972
comb 4	9.3979
.00933	$\bar{2}$.9699
24	1.3802
	$\bar{1}$.3501

224

059
2
118
11
107

No 12.109

8992

.0093.31
24
37324
18662
.223944

223 : 133 :: 100 : 59.7

2.7235
$\bar{3}$.7443
7.6517
$\bar{3}$.5175 .00329 Ohms

$\bar{1}$.0176
$\bar{3}$.5175
1.5001

31:1 Ratio

2.0792
1.5001
5791
1.7226
1.7017

3.84 H.P.
per sq. inch
50.4 lbs

184

To save 1 H.P.

2 cts per hour
5
10 cts per day
$36.50 per year
365 capitals

Wt Cu. wind

	.02239	T.35500
$163	9.258	0.96655
	12.	1.07792
	39	1.59111
	.32	T.50051
	310 lbs	2.49199
	.85	T.50441
		2.03660

$108

.765
.0625
.7075
66
6|637
106

16)100(6.25
96
40
32
8

1.75
16
5|637
1274
4
.5096

1.7871
1.6911
.7960
.3010
.8750

.805 space at 20 inches

.785 space in 19.5 inches

.109
6
.654
66
.720
625
.095

.109
4
.436
44
.480
.180
.020
19.500

.1059
4
236

No. 12 wind fills space 785

20.510 inches

allow .04 for space between walls

make opening 20.5 inches

No. 12 .109 in. diameter

If the machine is made 19.5 inches diameter of armature this can be easily put in place. The resistance of the machine will be .0043 ohm on 24.2:1 as the ratio when 960 lamps are on.

4.9 H.P. will be lost on the armature or 65.7 H.P. per square inch.

□ square is $\frac{4}{3.14}$ times the circle

120	.14400
109	11881
104	
484	
100	
11881	

144 7.8.4115
119 2.1075
4 0.6021
.5191

3.3

Though space could be economized by using square wire 9 prefer to use round wire. Round wire is not apt to bruise at the ends and it can be far better wound and managed.

9.258 | 0.96655
39 | 1.59111
361 feet | 2.55766

Total wire 4X6 = 24 wires

24 | 2.55766
Total 8670 feet | 1.38062
ft per M. 2.78 | 3.93828
311 lbs | 1.44446
| 2.49382

calculated from Prescott

310 lbs calculated from cross section

311 lbs | 2.49382
Ohms per M. .0242 | 2.38382
comp 24 = 96 | 8.01777
comp | 2.89553
comp 24 | 8.61948
| 3.51501
.00328 Ohms

109
104
981
109
11881

1764 | 3.24654
96 | 1.98232
169300 | 5.22886

11881 | 4.07494
24 | 1.38062
285000 | 5.45549

285) 169.00 5-5-5 ÷ X

3.74443
2.22792
7.54553
3.51773

.00329 Ohms

small machine

9.258
3.333 = 40 inches
5.923
1.666
4.257

.592
75

Coeffs
296

comps 6
75
1.49
.005 85
2 1 3

1. 8751
7. 6902
3. 7672
1 3325

4.26 X 2 X 75 X .005 85
4 X 6
2

4.26
75
.005 85
comps 12

1.6294
1.8751
3.7672
2.9208

.155 Ohms 1.1925
3.7672
1.4258
.004 31
3.6345
.115 Ohms 1.0598

39 turns
30
1170 inches

90 1.9542
1170 3.0682
2.8860

.076 Volts per inch

May 25 1880

600
5400 54 Volts from present Large machines at 600

54
2
108 if two turns

JWE

May 25 1880

20 inches 62.83 circum.

100 H.P.

8 lamps for 3 lbs of coal

3 : 2.5 :: 8 : 6.66

8

3 | 20.00

6.66

Lamps per indicated horse power on the engine

100 horse power will give

666 lamps in running

Resistance 700. Each lamp to have 100 Ohms on an average when hot.

7 | 100

.1428

May 25 1880

9 Volts from 20X10 machine at 100 revs by experiment

21.5 Volts on one quart

21.5	1.3324
21.5	1.3324
4.43	1.6464
1.94	9.7122
10.5200	4.0234
	4.5185

3.1 per H.P. .4951

If the distance is increased to twice as great 6.5 Volts may be taken as the amount native. 6.5 X 3 = 19.5 Volts large machine. 600 revs = 117.0 Volts

6

117 : 90 :: 75

	1.8751
	1.9542
	7.9319
57.7	1.7611

57 commutator blades

May 25 1880

Df Book 81 page 104
page 122 & 112

940 : 602 : 1625 : 400

2.7959
2.7789
1.0269
2.6017

No. 3	750 turns	43 Volts
No. 2	600	120
No 2	750	150 Volts

No 2 6 layers 39 coils
6
234 turns

No. 3 75 turns

	150	2.1761
No. 2	234	2.3692
		1.8069

.64 Volt per 2 turns
.32 per turn

May 25 1880

No 3 43 1.6335
75 1.8751
1.7584

.57 Volt per turn

.62 Ohm resistance No 2

Two layers 75 commutators
multiple arc = .14 Ohm
4 layers series = .56 Ohms

39 commutators

39	1.5911
75	8.1249
.56	1.7482
	1.4642

.29 Ohm
Df 6 times around 6/4 X .29

4 1.29
.0725
6
.4350
2
.86 Ohm

No. 2 probably wound 12 times around the commutator

$\frac{.64}{2}$ Volts to a turn

.32 Volt

600 : 525 :: 120 : 105

$\frac{.2}{1050}$

140 volts on No. 1 at 525 rev

525 : 750 :: 140 :

200 Volts

2.14 61	
2.87 51	
7.2797	
2.3609	
2.3692	
.1937	.19717

.468 Volts per turn

Distances iron from iron

		Volts per turn
No. 1	.81	.468
No. 2	.94	.32
No. 3	.16	.57

Everything is so mixed that it is impossible to tell without experiment what to decide as to the influence of distance of iron of armature from face of magnet in the E. M. F.

Tal

700 lamps in multiple
are .gives .1428 Ohms of
Machine as wound 39 coils

19.5	1.2900
39	1.5911
76 Volts	.88.11

In round numbers
3/2 the number of coils
9/4 the resistance

4/.00329 Thurs p. 189
.000822 5
.0079025

1428/20 = .00714

.1428	T. 1567
.0074	J. 8692
19.4 6 1	1.2855

200

60 light

62 (478

7.83 sq. inch to lamp

52 ft. lbs per sq. inch

700) 24.88

35.5 sq. inch. to lamp

45 ft. lbs per sq. in.

201

19.5 inches 1.2900

3.14 .4471

61.2 inches 1.7871

.109 nine

4

.436

1/16 .062

.498

.44

.542 1.7871

1.7340

2.0531

113

5 6W coils

7.00 0.8451

comp 6.66 9.1761

100 2.100 ww

33000 4.5185 6.5397

Comp 20.4 8.6904

170.000 5.2301

.176 2488 3.3959

68.4 1.8342

page 175 10 inch machine

By experiment Chicago 2.9

8 Volts from machine
running at 100 ~~0000~~ R.P.M.

$\frac{\overset{59}{\cancel{60}}}{24}$ Volts large machine

$\frac{6}{144}$ Volts 75 commutator

144 : 90 :: 75 : 46.9

	1.8751
	1.9542
144	7.8416
	1.6709

47 turns

5 miles

109

545
055
062
862

6

61.5 inches circum

61.5 × .662 = 1.7871 − 1.8209 = .9662

2) 92.5

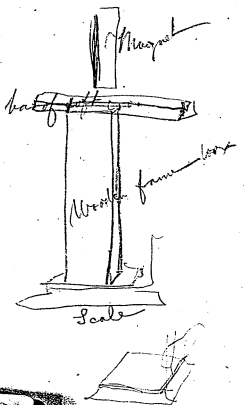
46.2 turns

If the machines pulsings
this is running very close

90 volts maximum effect

709

Experiment to be tried



Move the magnet along the bar and see if the attraction is not stronger in the middle than at the ends, by seeing how much weight is taken off

Plot curve of ~~the~~ magnetic taking Webers X No. turns as basis

T.E.

47^2 1.6721
1.6721

Comp 39^2 8.4089
8.4089

.00329 $\bar{3}.5172$

.00477 $\bar{3}.6792$

μ .199 A .1428 $\bar{1}.1547$
.00477 $\bar{3}.6792$
1.4755

Ratio 29.9 : 1

μ 201 A 6.5397
30.9 1.4900
112000 ft. lbs. 5.0497
3.3959
45 ft.-lbs. μ eq. incl. 1.6538

51 commutators decrease size of wire

5-13

1.7076 L 0

5.1228

5.3279

5.3279

3.6792

1.4578

8.3279

.0061 ohm 3.7857

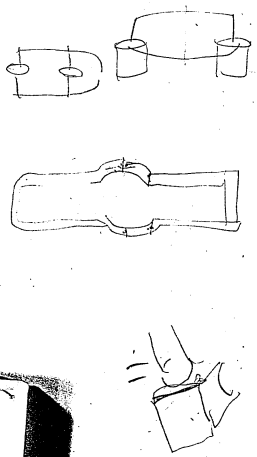
.6792

5.1065

1.0538

7.03

5716 ft. lbs. per sq. inch



6 | 33000
5500

Friction 1/2 4500
1/2

33000
8
2 | 264000
22000

14
~~14~~

22000
44000
4 | 22000
5500
4
22000

3 1/2

5057
3
15171
2526
17697

.87

5057

100
100
10000
441
40000
40035
44000
435
435
609
41

.87 | 5057.00

Friction balance. The 5500 ft lbs

Saving 1 armature,

.2200

14

TAF

11

4 ohm. 48

1 ohm

22000.

.14

Total 3½ armature

1.68 outside

1.6

17697

bottom armature

5½ 100

.84

3½

21
84

47 commutator No. 12 wire = 0".109 inch
.011" covering

Iron of armature 19".5 = D

19.5 circum 61.26 1.7872
47 X 2 = 94 1.9731
0".652 1.8141

Each division 0".652

5 wires $\frac{109}{\frac{11}{120}}$ $\frac{5}{600}$ wide

4 wires $\frac{120}{\frac{4}{480}}$ $\frac{2}{960}$ deep

Surface 19.5 inches diam

298.6
298.6
1837.8
2435. sq. in
245.0 sq. in.
20.46

Ends

61.26
30.
1837.80

TAB

329.
329.
1929.
2587. sq inches
26.00 sq. in

30 inches long
13 inches to reach from commutator to end
10
53
2
106. inches length coil

2290 To reduce to 2000 turns

Multiply E.M.F. by Wrong

2000
1698

Book 48 p. 113

3.301
3.2298
.0712
.0718
7.9995
8.1425

6.0718
7.9995
8.0713

Constant to reduce E.M.F to 25-20 f.p.m cutting speed and unit of wire with 2000 turns on magnet.

Armature Speed

Let A = r.p.m. armature
x = constant to multiply Emf or speed by to give this Emf at 2500 f.p.m.

$3.14 \times \frac{5}{12} \times A = \text{f.p.m. armature}$

$X = \frac{2500}{\frac{5}{12} \times A \times 3.14} = \frac{6000 \times X}{A \times 3.14} = \frac{1910}{A}$

6000

3.7782
.4969
3.2813
7.7905
0.0718

B
1910
Book 39 p. 15 Comp A 1620
1.18

Small wrought iron motor 291

Magnet Book 48 page 113

Turns 1698. 3.2299
Resistance 6.8 0.8325
25 2.3974

Constant to multiply Volts on magnet by to obtain Webers X No. turns. Webers from Volts

9.1675

Armature Book 48 page 118

37 Commutator Strokes
6 turns
4.5 inches
1.6666
0.7781
0.6532
3.0005

1000 inches of wire active on each side

Comp 6.9995

TAE

On magnet

4/12 #

	2.6149		184	1.5315
	2.3974			8.0713
1030	3.0123		.0401	8.6028
	1.47	.8109	42.3	1.6263
		2.3974		8.0713
1610		3.2083	.0498	8.6976
	7.61	.8814	47.3	1.6749
		2.3974		8.0713
1900		3.2788	.0557	8.7462
	8.73	.9410	50.6	1.7042
		2.3974		8.0713
2150		3.3384	.0596	8.7755
	10.8	1.0334	56.3	1.7505
		2.3974		8.0713
2700		3.4308	.0664	8.8218
	11.9	1.0755	59.6	1.7752
		2.3974		8.0713
2970		3.4729	.0702	8.8465

From armature

	15.2	1.1818	63.6	1.8035
		2.3974		8.0713
3800		3.5792	.0750	8.8748
	18.6	1.2695	67	1.8261
		2.3974		8.0713
4600		3.6669	.0789	8.8974
	31	1.4914	72	1.8573
		2.3974		8.0713
7740		3.8888	.0848	8.9286

TAE

.135 T. 1303
2.34 2.3692
amp 12 8.9208
2.63 .42.03

91
45
136

2.34 2.3692.
6.18 0.7910
3.14 0.4969
6. 0.7782
comp 17.37 6.7620
156 1.1953

Magnet reduction to 2000 turns

2000 3.3010
Both 41.33 1404 3.1473
.1537

Regular Core and Yoke

Armature

Length of armature 9"

2 X 75 = 150 turns
9
1350 3.1303
comp 1350 6.8697

Constant to reduce S. M. F. of machine to inch of wire on the armature

Magnet 1404 3.1473 TAE
comp 1.4 9.8539
1001 3.0012

Armature speed page 220

$X = \frac{2500}{\cdot \pi \text{ A } \frac{9.73}{12}} =$

Webers from Volts

9.8539

$A = 1048.$

$$X = \frac{2500}{3.14 \times 1048 \times \frac{9.73}{12}}$$

$$= \frac{27000}{3.14 \times 1048 \times 9.73}$$

0.4969
3.0204
0.9887
4.5054
4.4314
1.9260

$X = .843$

1.9260
4.8697
4.7957

Magnet

.952

Ratio 103 1.93

1.4786
3.0012
2.9798

954

Armature

16.3

1.2122
4.7957
2.0079

.0102

Magnet

1.14

0.0569
3.0012
3.0581

1140

Armature

22.2

1.3464
4.7957
2.1421

.0138

TAF

228 Magnet

1.561 → 3.0012 × 0.1934 = 3.1946

1560

dometure 3.2

1.5051 → 4.7957 = 2 3008

.02

1.862 → 0.2695 × 3.0012 = 3.2707

1860

39.3

1.5911 → 4.7957 = 2.3868

.0254

2.31 → 0.3636 × 3.0012 = 3.3648

2310

49.3

1.6928 → 4.7957 = 2 4885

.0307

3.612 → 0.5578 × 3.0012 = 3.5590

3620

73.3

1.8651 → 4.7957 = 2.6608

.0458

5.13 → 0.7101 × 3.0012 = 3.7113

5140

89

1.9494 → 4.7957 = 2.7451

.0556

TAS

Change of commutation

3.06 → 0.4857 × 3.0012 = 3.4869

3060

97

1.9866 → 4.7957 = 2.7826

.0606

Magnet to reduce to 2000 lines

Multiply E.M.F. Armature by

2000 / 1752

3.30103 / 3024 3

.05

7.1707

.6790

Magnetic

7.8497

Book 48 p 257

large 20" machine

Armature

To reduce to inch of wire

9 turns

75 turns

675 inches of wire active

comp 675, 7.1707

Magnet

To reduce Volts to Webers

multiply by 1/1.94 9.7122

1752 3.2435

9.7122

2.9557 TAE

Armature speed

$$X = \frac{2500}{\frac{20}{12}\pi A} = \frac{2500}{\frac{5}{3}\pi A} = \frac{1500}{3.14\,A}$$

3.1761

0.4971

478 2.6790

comp A 10 8.

.6790

Magnet Volts		Armature Volts	
1	2.9557	1.9	.2788
			7.8497
903.		.0134	8.1285
2.	.3010	3.9	.5185
	2.9557		7.8497
1810	3.2567	.0233	8.3682
3.	.4771	4	.6021
	2.9557		7.8497
2700	3.4328	.0283	8.4518
4	.6021	4.7	.6721
	2.9557		7.8497
~~3.58~~	3.8578	.0332	8.5218
~~3610~~			
5	.6990	5.2	.7160
	2.9557		7.8497
4510	3.6547	.0368	8.5657

10	1.	7	.8451
	2.9557		7.8497
9030	3.9557	.0495	8.6948
15	1.1761	7.8	.8921
	2.9557		7.8497
13500	4.1318	.0552	8.7418
20	1.3010	8.1	.9085
	2.9557		7.8497
18100	4.2567	.0572	8.7582
30	1.4771	8.25	.9165
	2.9557		7.8497
27090	4.4328	.0584	8.7662

TAE

Laws of winding Dynamo Machines

The resistance with A coils is R.

If the thickness of the wire be increased n times the resistance will be $\frac{R}{n}$

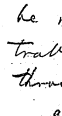
That is the wire will be n times as thick.

If the number of commutators be increased the cross section n times if the depth of wire remain the same and the width of the wire only decreases the resistance will be $n^2 R$. The current will travel n times as far through wire of $n^2 R$ resistance

If at the same time the thickness of the wire be decreased it will give a resistance of $n^3 R$.

If the size of the armature be changed so that it has a diameter n times as great, same thickness of wire. Length = 1. Diameter = 1

Wire n times as wide the length will = n + 1



TAE

940

The resistance will be $\frac{(n+1)R}{2n}$

If the length of the machine be made n times as great diameter remaining the same the resistance will be $\frac{(n+1)R}{2}$

If both diameter and length be altered the resistance will be R

Change of E.M.F. = E

n times the commutators

E.M.F = $n \cdot E$

n times the diameter

Machine proportioned same E.M.F = $n E$

of same number of r.p.m. 24

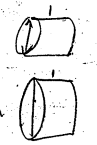
If same cutting speed

E.M.F = E

If n times the length of bobbin the E.M.F will be $n E$

The surface of armature = S

n times the diameter



TAE

$\frac{\pi n^2}{4} + \pi n :: \frac{\pi}{4} + \pi : S^1 : S^n$

$S = \frac{\left(\frac{\pi n}{4} + \pi\right) n}{\frac{\pi}{4} + \pi} \cdot S$

$= \left(\frac{\frac{n}{4} + 1}{\frac{1}{4} + 1}\right) n S = \left(\frac{n+4}{1+4}\right) n S.$

Surface $= \left(\frac{n+4}{1+4}\right) n\ S$

If the length be increased n times the diameter the same

$\frac{\pi}{4}+\pi : \frac{\pi}{4}+\pi n :: S : S'$

$S' = \frac{\frac{1}{4}+n}{\frac{1}{4}+1}\ S$

$= \frac{1+4n}{1+4}$

If length and diameter be increased n times

$S' = \frac{\frac{\pi n^2}{4}+\pi n^2}{\frac{\pi}{4}+\pi}\ S$

$= n^2 S$

General

No. Turns $= n$

Length $= a$

Diameter $= b$

Cross section wires $= c$

Resistance $= r$

E. M. F. $= e$

Surface $= s$

For another machine

No. Commutators $= n$

Cross section $= d = \frac{rc}{R}$ (1)

Resistance $= R = \frac{rc}{d}$ (2)

E. M. F. $= E = e$

Length $= a$

Diameter $= b$

Surface $= S = g +$

$R : r :: c : d$

$R = \frac{rc}{d} \quad d = \frac{rc}{R}$

TAE

Let turns = n

Length = A

Diameter = B

Cross section = $C = \frac{Bc}{4}$

resistance = $R = \frac{A+B}{a+b}\frac{b}{B}r$

E.M.F. = $\mathcal{E} = \frac{A}{a}e$

Surface = $S = \frac{B^2+4AB}{b^2+4ab}\,a$

The cross section of the wire will be

$c : C :: b : B$

$C = \frac{Bc}{b}$ (3)

The change of resistance due to this will be

(4) $R' = \frac{rc}{C} = \frac{cr}{\frac{Bc}{b}} = \frac{br}{B}$

The change of resistance due to the length and diameter will be

$R' : R :: a+b : A+B$

$R = \frac{A+B}{a+b}R'$ (5)

$R = \frac{A+B}{a+b}\frac{b}{B}r$

$\mathcal{E} : e :: A : a$ Same surface speed

$\mathcal{E} = \frac{A}{a}e$

TAE

Surface

$S' : a :: \frac{\pi B^2}{4} + \pi BA : \frac{\pi}{4}b^2 + \pi ba$

$S' = \frac{B^2+4AB}{b^2+4ab}\,a$

No. turns = n wanted
Length = A
Diameter = B.
Cross section = C
Resistance = R
E. M. F. = e Constant
Surface = $S = \frac{B^2 + 4AB}{4} \pi$.
Speed of wire = sp.

Then $A : a :: n : N$

$$A = \frac{an}{N}$$

$$N = \frac{an}{A}$$

Length
Resistance
If other

$n : n :: c : c'$

$$C = \frac{N_c}{n}$$

E. constant
A varying

250

100 Ohm Lamps

		100.	101 Ohms
		1 Ohm 101	
2			
3	1 Ohm	50.24	
		51.24	
4	1 Ohm	34.16	
		35.16	
5	1 Ohm	25.99	
		26.99	
6	1 Ohm	21.26	
		22.26	
7	1 Ohm	18.12	
		19.12	
8	1 Ohm	16.05	
		17.05	
9	1 Ohm	14.56	
		15.56	
10	1 Ohm	13.46	
		14.45	
	10hm	12.62	9
		13.62	
			100 Volts

251

$$\frac{1}{R} = \frac{1}{R'} + \frac{1}{R''}$$

$$R = \frac{R' R''}{R' + R''}$$

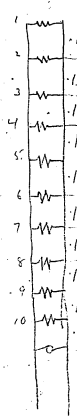
10100

201) 10100 (50.25
1008
500
402
98

150.24) 5124. (34.105
5124
TAE
3

150.24) 5124.0 (34.105
45072
5120
600 96
150 24
8

135.10) 3510.5 (25.99
27020
808 50
675 50
133 000
120 390
12 610



1	10			94.76
2	100.1			94.84
	50.02	50.02	2	
	50.12		2	
3	33.32	33.32	4	95.
	33.49		6	
4	25.1	25.00	10	
	25.2		1	95.3
5	20.11	20.	81	
	20.21		4	95.7
6	16.81	16.66	15	
	16.91		5	96.1
7	14.48	14.28	20	
	14.58		4	96.7
8	12.71	12.5	21	
	12.81		4	97.4
9	11.36	11.11	25	
	11.46		4	98.2
10	10.29	10	29	99.1
	10.39			
			100	

V is Y

$R = \frac{R' \cdot R''}{R' + R''}$

10001	4.0004
5001	2.3012
5002	1.6992
50.12	3.7000
150.12	2.1764
	1.5236
3349.	3.5241
133.49	2.1252
	1.3989
2530.	3.4074
125.3	2.0982
	1.3092
2021.	3.3055
120.21	2.0799
16.81	1.2256
1691.	3.2282
116.91	2.0679
	1.1603
11458.	4.0591
	1.1042
	1.1377

TAE

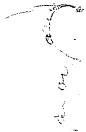
1281 | 3.10077
112.81 | 2.05226
1.05555
38
3.10593
11146 | 2.04770
1.01223
42
1.01165

1.00000
42
.99558
38
.99220
35
.98865
30
.98555
26
.98229
21
.98008
17
.97791
13
.97778
8
.97770

.9778
.9764

The question the mass of the 285-
the [illegible]

Radix [illegible]

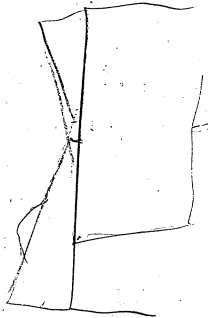


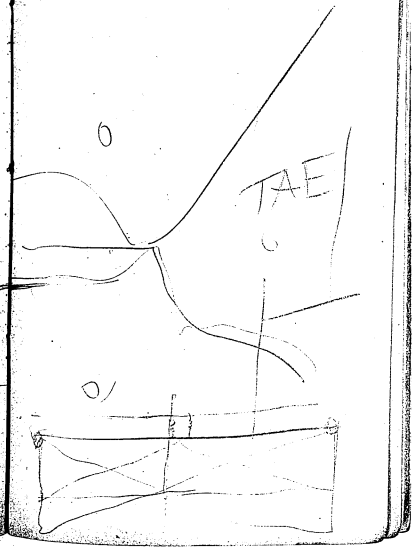
180 Lamps
220 Lamps
320 Lamps

22/665 lbs
30
60 cts.

~~700 feet out~~

490 feet out.





To square 1

1320
185
226
235
29
10
264
61
87
36

9276

235
140

1 foot lb = 0.1380 kilogrammetre.
1 kilogrammetre = 7.2331 ft lbs.
1 Calorie (kilogramme of H_2O heated 1°C.)
4.24 kilogrammetre = 3,9683 heat units Fah

/

5.00 | 165.
.20

TAE

TAE

39 78

Menlo Park Notebook #38 [N-79-07-07.2]

This notebook covers the period July 1879. Many of the entries are by Francis Upton. There are also entries by Edison, Charles Batchelor, and Francis Jehl. Material by Upton consists primarily of calculations relating to conductors, electric power distribution, and generators. Material by Edison includes notes and drawings of filaments and lamps; drawings and calculations relating to electric power distribution; notes on thermoelectricity experiments; notes on journal articles; and notes on induction coils for the telephone. There are also drawings by Batchelor of the telephone and notes by Jehl on wire tests. The book contains 282 numbered pages.

Blank pages not filmed: 148-149, 194-253, 256-273.

(No 38

17
3
1

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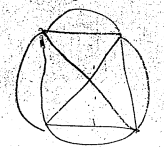
BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

GENERAL ELECTRIC.

May 1, 1896.

No 38



5
5
16
16
32
1

Thermo experiments

Telephone lampblack (lamped
in 1/4 inch tube 2 inch of lampblack
large copper wires for tube
Thomsons 3/4 ohm Mirror-
heat candle, no apparent deflection
(Light immediately galvanometer in table
walking disturbs it)

With Hyperoxide Lead, 350 deg
deflection - Equals Daniels
Cell through 8.40 ohms
to the left =

Iodide Copper about
200 deg to left =

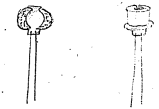
Vapor of mercury does not attack gold at high temperatures, (or any metal perhaps) but when heated it dissolves at once,
Daniells - Phil Mag Vol 1 1832 page 263

Singular change of texture of platinum exposed to high temperatures near plumbago — attributed by London. Mfr. of platinum to Sulphur &c. The French to presence of iron which "mere presence communicates at low temperature to platina. Daniel says plunged platinum in molten iron without change Daniels finally ascertained that it was due to Silica it takes up 3 per cent, a temperature considerably above melting point of cast iron is required to effect this combination. Descotils & Chenevix obtained this combination of Pt with Silica by heating platina with black lead ware — Bousseingault found that there was no effect when Pt was heated with Lampblack
Daniell Phil Mag Vol. 1. 1832-p 269

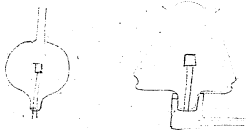
first stating Telephone
Chaldini Vol 4. Phil Mag.
of 1799 — page 118 two persons converse
by holding a stick in their teeth (
upon teeth,) & close their ears -
also when thread was held in the teeth.

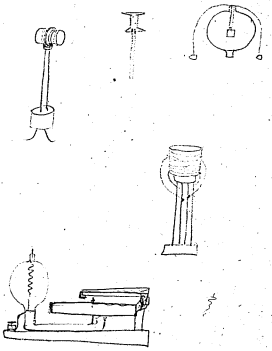
The use of a long wire same
purpose - page 379 Vol 14
Phil mag. 1799 — by
D Whyte —

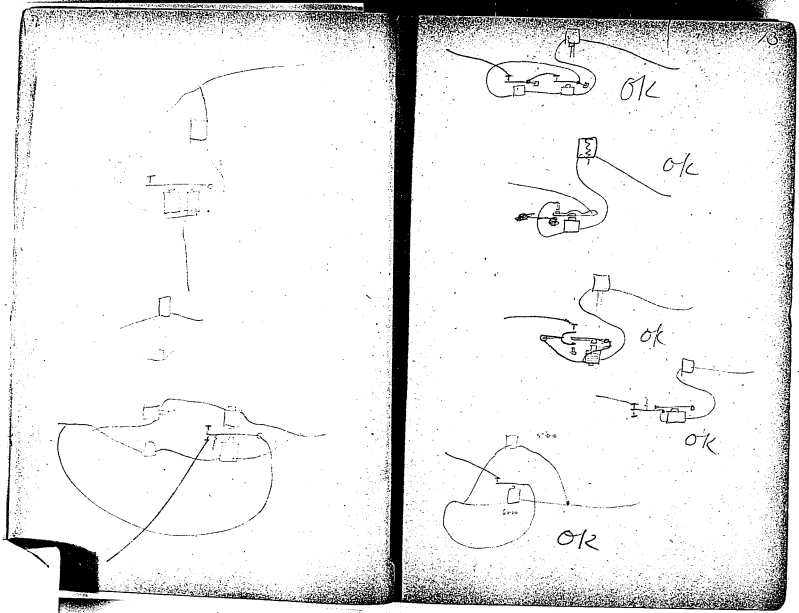
Giesslin tubes first spoken
of - Phil Mag Vol. 6 of 1800,
page 246 - Tremery



Bobbins of Hydraulic pressed aluminum, Silicon, Zirconium and oxides of the cerium group — Magnesium, Calcium, Carbon —






OK
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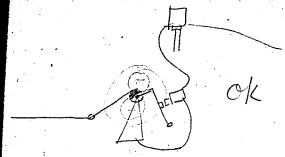
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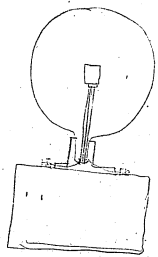
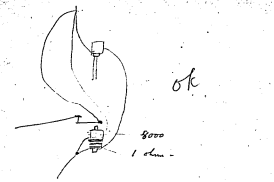
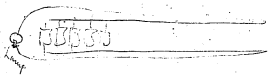
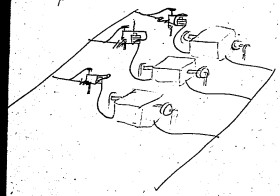
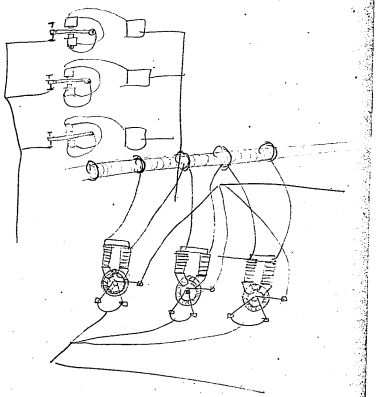
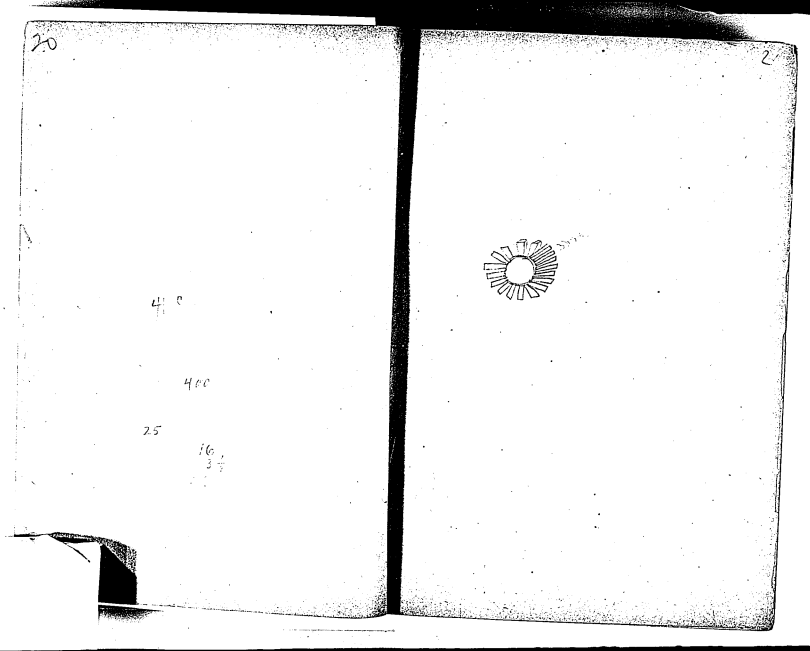


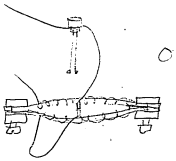

ok
good
I dun -








20
2
4 8
400
25
16
3



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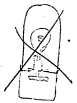
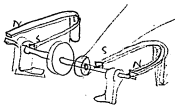


ok -

rounding metal

ok



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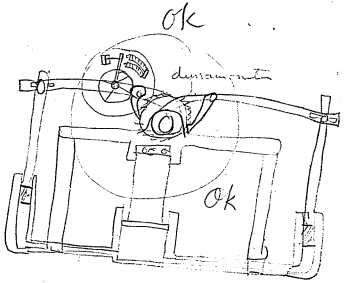


Get the diagrams
according to the number
Engine =

after winding each Layer of
paper moistened with Size cover the
whole with paper moistened in
& then wind the other Layers

30

$x^3 - 8x^2 + 19x - 14$

$x^4 - 7x^3 + 8x^2 + 28x - 48$

$x^4 - 7x^3 + 8x^2 + 28x - 48$ | $x^3 - 8x^2 + 19x - 14$ | $x + 1$

$x^4 - 8x^3 + 19x^2 - 14x$

$x^3 - 11x^2 + 42x - 48$

$x^3 - 8x^2 + 19x - 14$

$-3x^2 + 23x - 34$

$x^3 - 8x^2 + 19x - 14$ | $-3x^2 + 23x - 34$ | $-x + 1$

$3x^3 - 24x^2 + 57x - 42$

$+3x^3 - 23x^2 + 34x$

$-x^2 + 23x - 42$

$-3x^2 + 69x - 126$

$-3x^2 + 23x - 34$

$46x - 92$

$x - 2$

31

$-3x^2 + 23x - 34$ | $x - 2$

$-3x^2 + 6x$ | $-3x + 17$

$17x - 34$

$17x - 34$

0

$17 - 3x$

$x - 2$

32

To find the Wt and cost of a conductor of Cu wire having one ohm resistance

Length ranging from 50 feet to 5000 ft. from 100 ft.

Law the Wt will increase as the square of the distance

To find the wt and cost for 20 ft add that unity multiply by 4, 9, 16, 25 36, &c

A Cu wire 1 ft. long weighing one grain after Jenkin p 249 has a resistance of .2064 Ohms.

a Cu. wire 1 ft. long weighing .2064 grains will have a resistance of 1 Ohm

will weigh .2064 grains

or $\frac{.2064}{7000}$ lbs.

a Cu wire 20 ft long having a resistance of 1 Ohm will weigh

$\frac{400 \times .2064}{7000}$ lbs

.2064

7000 | 82560

.01179 lbs

175 — 2.2430
comp 144 — 7.8416 −10
log 5760 — 3.7604
13.8450
7000 — 3.8450

7000 grains in lb. Adv.

60° Fahr = 15.5° C
32
28
9.710
1.555

Increase of resistance

1° C — .00384 — 3.5827
155 — 1.1923
.061 — 2.7850

.061177 — $\bar{3}.0700$
1.061 — .0258
$\bar{3}.0958$
.0124 lbs at 60° Farhr

a [illegible] wire 1 foot long .001 dia. in diameter has resistance of 9.718 ohms.

a dia wire 1 foot long having 1 ohm resistance will have a diameter of $\frac{\sqrt{9.718}}{1000}$ inches

when 20 feet long

$\frac{\sqrt{20}\ \sqrt{9.718}}{1000}$ inches

3h

$\sqrt{2}$ 1.3010

6505

$\sqrt{.7315}$ .7576

.4935

6505

4935

2

.9139 2.1443

2c [illegible] wire 1 Ohm

[illegible] .0139 inches

[illegible]

at 15.5 C. 60° Fahr.

~~.7851~~ ~~2.7050~~

~~1.3525~~

$\sqrt{.0661}$ .0258

.0172

2.1443

.0143 inches 2.1572

Prague

1 Ohm of wire .001 inch in diameter has a length of .09674 mt

1 Foot of wire same diameter of 1 Ohm [illegible] with length a diameter

$\frac{1}{2}$ $\frac{1}{2}$

$\frac{1}{.09674}$ in.

11.01490 of

3.50073 .00321 m

3.50073

$\sqrt{12.25}$ .6505

2.1578

2.3 feet with resistance of 1 Ohm

$\Delta = .0143$

2.1576 [illegible] Diameter

4.31 2.3

A foot of wire .001 in in diameter weighs

.0[illegible]

1 Ohm of Cu wire .001 in in diameter weighs

$\frac{1}{3,417,000}$ lbs

As a wire 20 feet long having an insulation 1/64 in thick & diameter of .143 inches it will weigh

14.3 grams

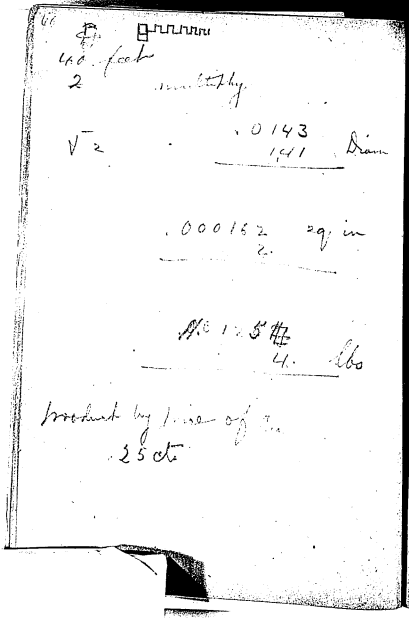
[illegible]

1.1575
1.1575
3.4664 - 10
5.7814
5.7814
20 1.3010 Log 20
3.0824
.001204

Sprague .001254 lbs
Carbon .00124

2 1.1576 Conductor 1 Ohm
.3010 20 feet long
3.8566
3.8566 Cross Section of
.4971
4.2103 .000162

This & the constant by 2 for conductor of 40 feet and so on



440 feet
2 inch thy

$\sqrt{2}$ .0143
1.41 Diam

.000152 sq in
2

4. lbs

Product by 1 inch of 2"
.25 cts

60

3 $\sqrt{3} = 1.73$
$3^2 = 9.$

$\sqrt{4} = 2$
$4^2 = 16.$

100 $\sqrt{5} = 2.23$
$5^2 = 25$

$\sqrt{6} = 2.44$
120 6
$6^2 = 36.$

140 $\sqrt{7} = 2.64$
7
$7^2 = 49$

160 $\sqrt{8} = 2.82$
8
$8^2 = 64$

180 9 $\sqrt{9} = 3$
$9^2 = 81$

200 10 $\sqrt{10} = 3.16$
$10^2 = 100$

.0143
.00725
3.1860 3
3.1860 3
.4971
.2177

165

12 Length

660 1/8 mile

1220 1/4 mile

1760 1/3 mile

2640 1/2 mile

5280 1 mile

of Ohm wire

2 · 6046.5 feet Lineham

1 Ohm resistance

2) 6046.5

302.325 Ohm 20

.0143 2.1153
2.2296
1.2140
7.3955

.248 in in diameter

6046.5
5.29
1140 lbs
$285 cost

3.7816
.7335
3.0581

3.7816
3.7816
11.012.08 2.0420
5.6245
20 1.3017
4.3442

4.3442
1.3017
3.0425

~~1105~~ lbs
1105 lbs

comp 1550
20

3.5097
1 3010
1.1107

10129

.00642

A wire 21.5 feet long weighs $21.5 \times \frac{1}{1088.1}$ lbs. and has a resistance of 1 Ohm. How much will a wire 20 feet long having a resistance of 1 Ohm weigh

$$\left(\frac{21.5}{20}\right)^2 \left(21.5 \times \frac{1}{1088.1}\right)$$

$$\frac{20^2}{21.5^2} \left(21.5 \times \frac{1}{1088.1}\right)$$

$$\frac{20^2}{21.5} \left[21.5 \times \frac{1}{1088.1}\right]$$

1.3.10
1.33.10
8.33.5 -10
6.8272 -10
1.1970

1.1970

.0125

A wire one foot long weighing 1 grain has a resistance of .2064 Ohms

If a wire 1 foot long has a resistance of .2064 ohms it weigh .2064 grains

$\frac{.2064}{7000}$ lbs

a wire 20 ft long having a resistance of 1 ohm will weigh

$20^2 \times .2064$ / 7000

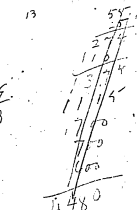
$= \frac{20^2 \times .2064}{7000}$

$\frac{4.128}{3}$

.2064

.70 | 8.256

.01179



.4480

1 wire 20 feet long weighing having a resistance of 1 ohm at 0°C weighs .01179 lbs

a wire .09674 feet long having a resistance of 1 Ohm weighs

$\frac{1}{3.417000}$ lbs.

What will a wire 20 feet long having a resistance of an Ohm weigh

$\frac{20^2}{.09674^2}$ $\frac{1}{3.417.000}$ lbs

20 / 1.2070
20 / 1.3010
11.01444 -10
3.4662 -10
7.0826
11.0144
18.0970

2. 0.970 .0125

A wire 20 feet long ~~weighing~~ having a resistance of 1 Ohm weighs .0125 lbs

20 / 1.3010
7.5
.0125
75
625
875
.9375

52

2000 feet in 5 times

07

.143 m = D

( ).

.0162 D m = 0.8

( )²

125 ft

$31.25 cost

202 m

101 times

144

1.0021
1.1574
143

2.0043
2 2138
.0163

4.0086
2.1055
127

3.3054
1.5229
6.6708

3.3054
1.5229
1.7825
1.7825
6.6108
4.7077

2040
102 times

1.0043
1.1596
.145

2.0086
2 2181
.0165
.0085

4.0172
2.1141
4 | 13.0.2.
3 2.5 5

103

1.0064
1.1617
.146

2.0128
2 2223
.0166

4.0256
2.1225

132.
34

15 100 13

JU

104

.145	1.0085 / T 1638
.0168	2.0170 / Σ 22265
135.2	4.0340 / 2.1309
~~33.8~~	

105

.147	1.0104 / T.1659
.0170	2.0274 / Σ 22307
137.8	4.0424 / 2.1393
~~34.45~~	

106

.147	1.0126 / T.1679
.0172	2.0253 / Σ 22348
140.4	4.0506 / 2.1475
35.1	

107

.148	1.0147 / T.1700
.0173	2.0294 / Σ 22389
143.2	4.0588 / 2.1557
35.8	

10.8

.1486

1.0167
1.1720

2.0334
2.2439

.01754

4.0668
2.1637

145.6
36.40

109

.1493

1.0187
1.1740

2.0374
2.2469

.01766

4.0748
2.1717

148.5
37.12

110

.1502

4.0207
1.1766

2.0414
2.2540

.01782

4.0828
2.1777

151.2
37.80

111

.1506

1.0226
1.1779

2.0453
2.2548

.01798

4.0906
2.1876

154.0
38.50

112

.1513

1.0246
1.1798

2.0492
2.2587

.0181

4.0984
2.1953

.1565
39.20

113

.152

1.0265
1.1818

2.0531
2.2626

.0193

4.1062
2.2621

.1595
39.62

114

.1526

1.0284
1.1837

2.0569
2.2654

.0184

4.1138
2.2107

.1623
40.57

115

.1533

1.0303
1.1856

2.0607
2.2702

.0286

4.1214
2.2783

.1653
41.32

116

.154 | 1.0322 / 1.1875

2.0645 / 2.2746

.01879

4.1290 / 2.2259

168.
42.

117

.1546 | 1.0341 / 1.1892

2.0682 / 2.2777

.01896

4.1364 / 2.2333

171.2
42.80

118

.155 | 1.0359 / 1.1912

2.0719 / 2.2814

.01913

4.1438 / 2.2407

174.1
43.52

110

.1559 | 1.0377 / 1.1930

2.0755 / 2.2850

.01928

4.1510 / 2.2479

176.9
44.22

62

120
20
2480

.1587

1.0396
1.1949

D. cum

2.0792
2.2887

Brass

.1965

4.1584
2.2553

Weight

180.
45.

121

1.0414
1.1967

.1573

2.0828
2.2923

.0196

4.1656
2.2625

183
45.75

62 63

.1579

1.0432
1.1985

2.0864
2.2959

.01975

4.1728
2.2697

186.1
46.52

123.

1.0449
1.2002

.1585

2.0899
2.2994

.01995

4.1798
2.2767

189.2
47.40

124

.1593

1.0467
1.2020

2.0934
2.3029

.02008

4.1868
2.2837

192.2
48.05

125

.1597

1.0484
1.2037

2.0969
2.3064

.02025

4.1938
2.2907

195.3
48.82

126

.1605

1.0502
1.2055

2.1004
2.3099

.02042

4.2008
2.2977

198.5
49.62

127

.1615

1.0529
1.2082

2.1038
2.3133

.02058

4.2076
2.3045

201.5
50.37

128

1.0536
1.2089

.1615

2.1072
2.3167

.02873

4.2144
2.3113

2048
51.20

129

1.0553
1.2106

.1622

2.1106
2.3201

.0209

4.2212
2.3181

208.
52.

130

1.0569
1.2122

.163

2.1139
2.3234

.2105

4.2278
2.3247

211.1
52.77

131

1.0586
1.2139

.1635

2.1173
2.3268

.02122

4.2356
2.3325

215.1
53.25

1.0603
1.2156

.1643

2.1206
2.3301

.02138

4.2412
2.3381

217.8
54.45

133

1.0619
1.2172

.1649

2.1239
2.3334

.02155

4.2478
2.3447

2212
55.30

1.0635
1.2188

.1655

2.1271
2.3366

.02171

4.2542
2.3511

224.5
56.12

135

1.0651
1.2204

.166

2.1303
2.3398

.02187

4.2606
2.3575

227.8
56.95

136

1.0667
1.2226

.1667

2.1335
2.3830

.02203

4.2670
2.3639

231.2
57.80

137

1.0683
1.2236

.1473

2.1367
2.3462

.0222

4.2734
2.3703

234.6
58.65

138

1.0699
1.2252

.168

2.1399
2.3494

.02236

4.2798
2.3767

238.1
59.52

139

1.0715
1.2268

.1686

2.1430
2.3525

.02252

4.2860
2.3829

241.5
60.37

140

1.0730
T 2283

.1691

2.1461
2 3556

.02268

4.2922
2.3891

245.
61.25

141

1.0746
T 2299

.1698

2.1492
2 3587

.02284

4.298
2.3953

248.5
62.12

142

1.0761
T 2314

.1704

2.1523
2.3618

.02301

4.3046
2.4015

252.1
63.02

143

1.0776
T 2329

.171

2.1553
2.3648

.02316

4.3106
2.4075

255.6
63.90

74 144

1.0492
1.2345
.1716

2.1584
2.3679
.02332

4.3168
2.4137
259.2
64.80

145

1.0807
1.2360
.1722

2.1614
2.3709
.0235

4.3228
2.4197
262.9
65.72

146

1,0822
1.2375
.1728

2.1644
2.3739
.02365

4.3288
2.4257
266.5
66.62

147

1,0836
1.2389
.1734

2.1673
2.3768
.02382

4.3346
2.4315
270.1
67.52

148

1.0851
2.2404

.1740

2.1703
2.3798

.02397

4.3406
2.4375

273.9
68.47

149

1.0866
1.2419

.1744

2.1732
2.3827

.02414

4.3464
2.4433

277.6
69.40

150

30000

.1750

1.0880
1.2433

1.2432
.4010
2.7623
2.9423
.4971
2.3817

.0243
.02401

2.1761
2.3856

4.3522
2.4411

281.3
70.32

151

.1758

1.0895
1.2448

2.1790
2.3885

.2446

4.3580
2.4549

285.
71.25

150

.1760

1.08804
1.24564

1789
1752
37
74

2.17609
3.38659

5 81
162

2812

4.35218
2.74908

2515
2434
81

3000.3
2812
188.1

3.82

151 .1752 .024902 2850
152 .1775 .024664 2848
153 .1798 .024826 292
154 .1771 .024788 296
155 .1789 .025150

155

.1789

1.0951
1.2527

.02515

2.1903
2.4006

4.3806
2.4777

300.3

1818
1789
29
8

2597
2515
82
16

300.3
188.1
189

155 .1789 2615 3000.3
156 .1795 2531 3004.2
157 .1801 2547 3018.1
158 .1807 2563 3032.1
159 .1813 2580 3160
160 .1818 2597 320

60 160

1.10.20
7.2546

.1819

2.2041
2.4144

.02597

4.4082
2.5051

320.

	1846	2674	3419
	1818	2597	320
	28	77	219
5	5.6	5.2	4.4

160	1818	2597	320
	1823	2612	3244
162	1829	2628	3288
163	1835	2643	3332
164	1841	2658	3376
165	1846	2674	3419

165

.1846

1.1087
1.2553

.02674

2.2178
2.4831

4.4370
2.5339

341.9

	1874	2759	361.2
	1846	2674	3419
	28	85	19.3
5	5.6	1.7	386

166	1846	2674	3419
166	1852	2691	3457
167	1857	2708	3496
168	1863	2725	3535
169	1868	2742	3573
170	1874	2759	3612

C2 170

1.1152
1.2728

2.2304
2.4407

4.4608
2.5577

	1902	284	382.8
	1874	2759	361.2
	28	81	21.6
	56	162	432
170	1874	2759	361.2
171	1879	2775	3655
172	1885	2792	3677
173	1890	2808	3720
174	1896	2824	3763
175	1902	284	3828

175
20
3500

1.1215
1.2191

2.2430
2.4533

4.4860
2.5729

1928	2922	405.1
1902	284	382.8
26	82	22.3
52		4.46

Length	Diameter	Cross Section	Weight, Gross
3750	(75) 1902	.0284	~~382.8~~
3870	(76) 1907	.0285	387.26
3940	(77) 1912	.02872	391.72
3960	(78) 1917	.02922	396.18
3980	(79) 1922	.02964	400.64

84 180

.6928

1.1276
1.2452

.02922

2.2553
2.4685

405.1

4.5106
2.6070

1955
1928
27

3004
2922
82

427.9
405.1
5 | 2228
450

D
84 .1928
85 .1933
86 .1938
87 .1944
88 .1949

.02922
.02938
.02954
.02970
~~.02986~~
.02986

weight
to 5.1
409.66
414.22
418.78
423.34

3002

185

.1955

1,1336
1.2912

.03004

2.2672
2.4775

427.9

2.5344
.0313

1983
.1955
28

3084
3004
80

4514
4277
5 | 2235
447
weight

D
85 .1955
86 .1960
87 .1966
88 .1971
89 .1977

.03004
.03020
.03036
.03052
.03068

427.9
432.6
437.3
442.0
446.7

.1973

1.1394
1.2970

2.2788
2.4891

.03084

4.5576
2.6545

451.4

2007
1983
24

3165
3084
81

4784
451.4
8|24 0
4.8

2007
1983
24

(90) .19838
(91) .19878
(92) .19974
(93) .19974
(94) .20022
(95) .20070

+.02014
.0310
.03116
3132
3165

451.4
456.2
461.0
465.8
470.6

.2007

1.1450
1.3026

2.2900
.03165

4.5800
2.6774

4784

2033
2007
26
5

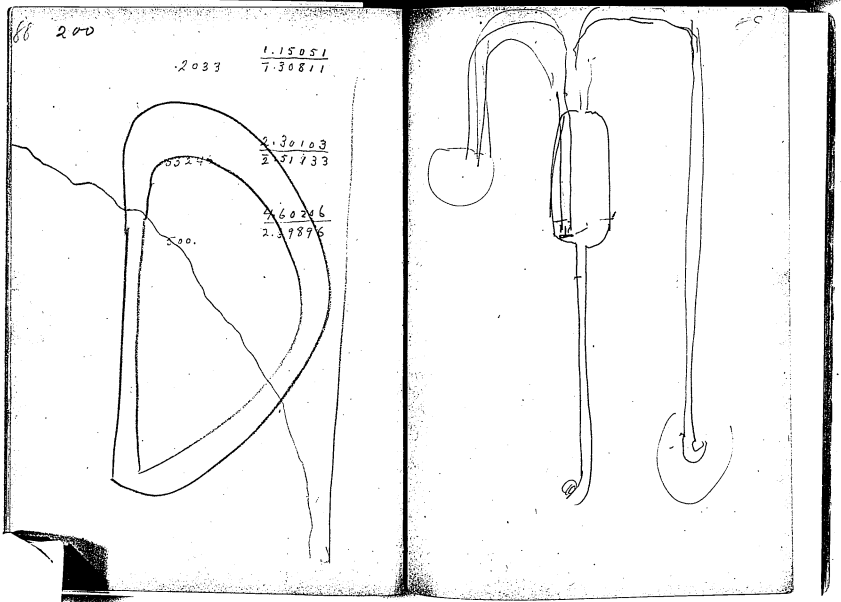
.2007
.20122
.20174
.20226
.20278
.30330

.03165
3181
3229

3165
3054
81

5206
4784
1246
4.92

415.14
420.32
425.24
490.16
495.08


88 200
.2033
1.15051
7.30811
2.30103
2.51733
.0324
4.60206
2.39896
200.

90

~~No. 1~~

Straight wire 1/4 mile long 1000 lamps every 25 feet 10 lamps in house

100 Houses

4/5280

1320

2640

25/1320

1320

.13.

26

1/4 Mile

9

Houses on each side every 25 feet

That is 20 lamps each 25 feet 2 conductors of 10hm each length

1	50 feet	100	17	450	32	850	
2	75	150	18	475	33	875	
3	100	200					
4	125	250					
5	150	300					
6	175	350					
7	200	400					
8	225						
9	250						
10	275						
11	300						
12	325						
13	350						
14	375						
15	400						
16	425						
			30				
			31	825			

			1250
			1275
		50	1300

50	100	.31
75	150	.71
100	200	1.25
125	250	1.95
150	300	2.81
175	350	3.92
200	400	5.00
225	450	6.40
250	500	7.81
275	550	9.40
300	600	11.25
325	650	13.3
350	700	15.31
375	750	17.55
400	800	20.
425	850	22.6
450	900	25.31
475	950	27.25
500	1000	31.75
525	1050	34.55
550	1100	37.81
575	1150	41.20
600	1200	45
625	1250	48.8
650	1300	52.8
675	1350	56.9
700	1400	61.2
725	1450	65.7
750	1500	70.3
775	1550	75
800	1600	80
825	1650	85
850	1700	90
875	1750	95.7
900	1800	101.2
925	1850	1264.84

35
2
70

126484
2
70 | 2480.08
35.43

126
1264.84

1264.84

194

2289
1264 1
2a | 5288 | 3553
264
80
888.
214 feet

2 | 6878
3439
1000 lamps

700
888
1719.
2607

$1.79 per ft

Pull out bar of wire			lbs of wire
925	1850		106.2
950	1900		112.8
975	1950		119.8
1000	2000		125.
1025	2050		131.1
1050	2100		137.8
1075	2150		144.9
1100	2200		151.2
1125	2250		157.1
1150	2300		165.3
1175	2350		173.
1200	2400		180
1225	2450		187.5
1250	2500	50	195.3
1275	2550		203.1
1300	2600		211.1
1325	2650		219.6

2639.0

22878

Portland

211.1
2196
4307

1500
1500

$17.19 per house

2480
4398.6
4 | 6878.6
17196

1264.86
2289.3
3554.14

3554 houses

on one quarter of a mile
each with ten lamps equivalent

3554 lbs of Cu so that
each will have one ohm between
it and the central station
the houses beginning at 50 feet
from central station and being
25 feet apart up to 1275 feet

45250 / 1320 feet in ¼ mile

in one hundred houses
3554.14 / 2
710 228

71. lbs to a house
or as if the average house was 750 feet

Cost per ~~lamp~~ average
of 100 Cr 25 cts per Cr

471
$177.75
1.77 per lamp

interest yearly
17.7 cts per lamp

10.5 Webers

~~for~~ 16 candle ~~lamps~~ lamps from Lamps having about .65 ohm resistance

100 ohm Lamp ?

$\frac{100}{.65} = \frac{100}{.65}$ Times R'

$\frac{.65}{100}$ / 10.5 Webers on 100 ohm lamp to give the same effect

$\sqrt{.0065} = .08$

.0648 Webers

10.5
.08
.840 Webers

$\frac{1}{20}$ Volt

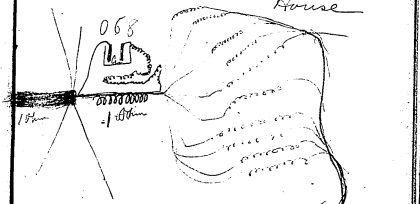
.05

6875 Volts on 1 Ohm

.06875 Volts

.06875

.06875 .06875



16

.0678

.0678

.0678

Where is the print point

What's your name?

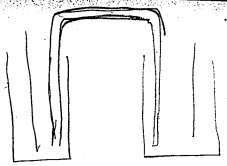
What do you want? Nothing.

What nothing? Yes nothing!

Daniells patent

50

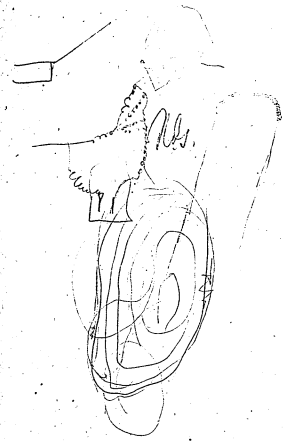
No. 1	Lamp 0 pay	.001 Grains
2	Lamp 0	.031
3	Lamp 0	.061
4	Lamp 0	.091
5	Lamp 0	.121
6	Lamp 0	.151
7	Lamp 0	.181
8	Lamp 0	.211
9	Lamp 0	.241
10	Lamp 0	.271

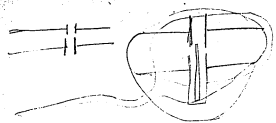


Hg So4

faults with this the acid will tend ~~to retain~~ dissolve the Cu. Plates 9 in — the Cu solution acid will be set free

16





$(a+n-1)^2$

1, 2, 3, 4, 5

1, 4, 9, 16, 25

$\frac{a^2+(a+1)^2+\dots}{5}$

$x^2+(a^2+2a+1)(a^2+4a+4)(x^2-5x+9$

$\lambda a^2+2(1+2+3+\dots+(n-1)x)$

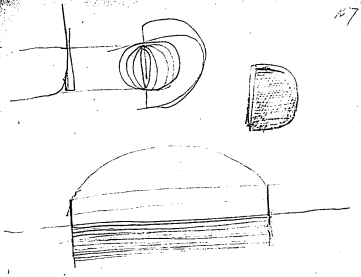
$1^2+2^2+3^2+4^2+5^2+6^2+\dots$

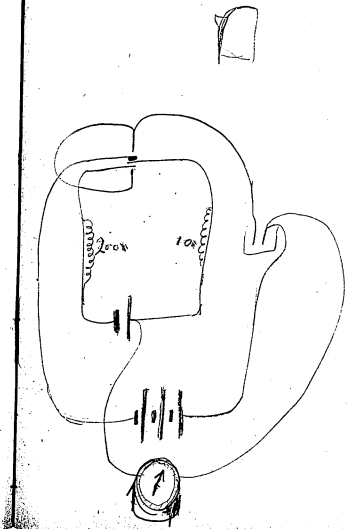
$1 + 2^2 + 3^2 + \dots + n^2$

$1 + 2^2 + 3^2 + \dots + n^2$

n

$1 + 2^2 + 3^2 + \dots + n^2$




200Ω
100Ω

$C = \frac{\mathcal{E}}{R}$

$C^2 R$

$R = a\,r$

$r = \frac{R}{a}$

$C' \frac{\mathcal{E}}{a} = \mathcal{E}$ energy

$\frac{C^2}{a}$

Question of a lamp have a resistance of R Ohms and a current of C webers. How great a current must be put through a lamp having $\frac{R}{a}$ Ohms to give the same light

$C^2 R = C_x^2 \frac{R}{a}$

$a C^2 = C_x^2$ $\quad C_x = C\sqrt{a}$

$C = \frac{\mathcal{E}}{R}$

1 Ohm ea

$\mathcal{E}$ = 100 Volts

10 Ohms total

1 Ohm lamp

Current = 10 Webers

$10 \times 1 = 100$ Energy

10 lamps

100 Ohm Lamps

Current = 1 Weber

100 = Energy

$C^2 R = C_x^2 R a_1$

$C_x = C^2 \sqrt{\frac{1}{a_1}}$

8 1/2

25 1/2

150

6 conches

10 Lamps 1 ohm

100,

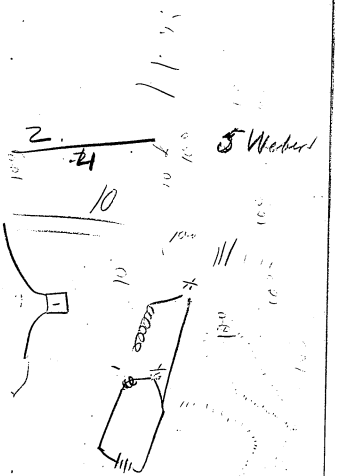
1000,

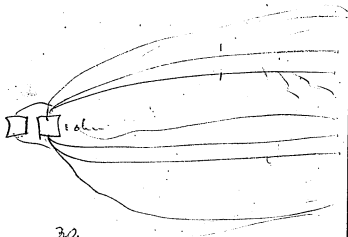
650,

666.

650. Red. 10 conn. 1.

& 10 100 c.p. Lamp Mul Arc,





24 30,

30, 25

20 20 20 40.

60 1

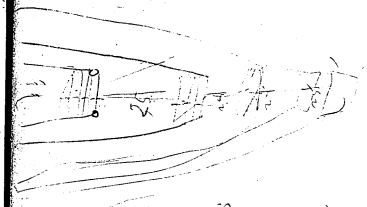
60 2

60 4

60 8

25.
12 1/2
6 1/4
3 1/8

1 100
2 50
4 25
8 12 1/2
16 6 1/4
32



2 11/16 3 1/2

3 1/2

4

2 1/2 3 1/2

Loss in Connexion, 10 pc

Loss in machine — 25

" Conductors 10

Station Connections

Safety Arrangements

Connections

" Lamps

50, Lamp engraved 3

Meter Shunt,

4 3/5 5

17.5

20. 20 20

17. 6 150.

100. 10 per year

200 1/2 3 int on 20 amps per inch

1/2 3/4 on connections,

1 1/2 6 power.

3/4 1 1/2

12. 4 1/2 c per day

50 ft

10 lamps 150 yards

3.5

120.

6 nights for Dallas

27. 36

27.

36

63.

18

81.

4 1/2 c per day

cut on 10 lamps

18

10,000.

50 2
25 4
12 8
6 16
3 32
1 room 64
7½ 128
325 1 256
162 512
81 1024

1,800 000

20) 397 (19¾
20
197
180
17

20) 367 (18
20
167
160
7

20 P. gilts

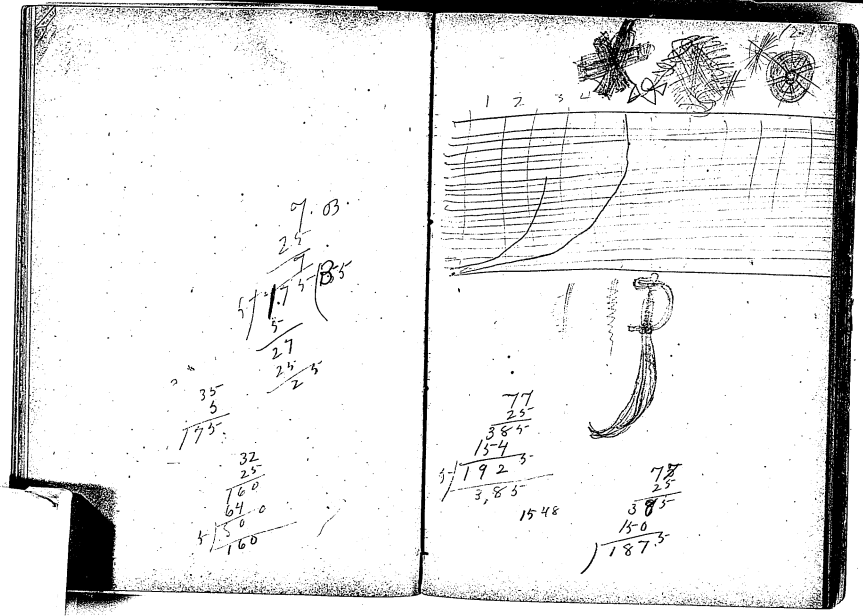
100 — Mac.
45 — Lamps
~~15~~ — Commutation Station
8 Belts.
10 Overshafting
87 — Horsepower plant
87 Boiler plant
5 Meter.
40 Conduits
10 Extra pairs

397
30
3 367

100 000
100
1,000,000

81,000
20
1,620,000

81000



225
25
1125
450
5625

65
25
325
130
1625

65 8
5
325

5

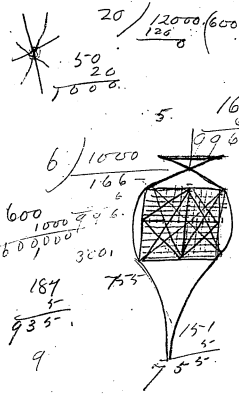
104
5
520

104
5
520

156.25

1670
5
835

8 · 160
6


20 / 12000 / 600
120
0
6000.
50
20
1000.
600
20
12000
5
166
6
600.
6 / 1000
166
6
600
1000
600,000
3001
166
6
184
5
935.
9
75
15-1
5
5 5.

ohm

1 - 1/2 . 5

6 1/2 ohm

15 7. 78

15 ~ 77

16. 8. 80

15 7 78

1700000

$ 176000

176000000

1st

1 , 1 , 10 –

8.3 8.3 83.

2nd . 1 . $\frac{1}{2}$ 5–

15.4 . 7.7 77

23 . 15 . 2 pc

17.

14– 77

$C = \frac{\varepsilon}{R}$ 15– 7

99–

$\frac{\varepsilon^2}{R}$

1 —— 99

2 97

4 —— 94

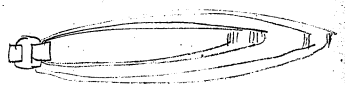
8 88

16 80

20 77. 23

25

$\frac{1}{2}$



$\frac{1}{2}$

1 1 $\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{2}$ 1 $\frac{1}{2}$

10 20 40 8 10 5 2 1 10 5

A magnet — 1 Ohms

$E = 10$ Volts

10 Webers

~~The~~ Strength 10.

Cost 100

The same sized wire is wound round again so as to have 2 Ohms resistance

5 Webers of current on 2 Ohms gives 10 Strength

if there is now weakening from carrying the wire further from over

Cost $5 \times 5 \times 2 = 50$

---

4 Ohms

2.5 Weber strength $= 2.5 \times 4 = 10$

cost

2.5
6.25
25 = Cost

---

8 Ohms

$1.25 \times 8 = 10$ Strength

1.25
1.56
8
12.50 = Cost

$R \times C$ = Strength

$C^2 R = \frac{\mathcal{E}}{R}$ Cost

$C = \frac{\mathcal{E}}{R}$

---

16 Ohms.

Strength $.625 \times 16 = 10$

Cost 6.25.

and so on the strength of the field being the same while the cost is lessened in proportion as the resistance is increased. ~~The~~

The cost of the machine is increased by the amount of wire. And as the efficacy of the wire diminishes, so when it is removed from the core a point is reached where there is no gain. This point to be found by experiment.

Thermo piles may be used with magnets under this condition. They give the constant E. M. F. which is ~~what~~ is required and may be used thus on a resistance which makes the resistance of the Thermo less

less in comparison.
Of course if a Thermo-
of low resistance could
be made it would be
the best as the current
varies very little from
Thermos, yet a high
resistance can be run
from them to great ad-
~~vantage~~ vantage the coil
being the wire around
the magnets.

Magnets ½ Ohm

Strength of current

195
5
980

185
5
925

1486
5
7430

1716
5
8570

100
1
1
50 : 1

Bp

100 Ohm Lamps

1 Ohm Machine

1 Ohm Conductor

100
2
102) 100

1

comp	102	7.9914	comp 101	2	7.9957
Log	100	2.		2.	
	198.	11.9914	99.		9.9957

2

comp	52	8.2840	comp 51	2	8.2929
log	50	1.6990			1.6990
		1.9830			1.9914
	96.1		98.		

Com	33.3				13
	2				
3 comp	35.3	2 8.4522	comp 34.3	2	8.4647
log	33.3	1.5224			1.5224
		1.9746			1.9871
	94.3	9492	97.1		

4	25	89			
	2				
comp	27	2 8.5638	comp 26	2	8.5800
log	25	1.4031			1.4031
		1.9669			1.9831
	92.6		96.2		

5	20				
	2				
comp	22	2 8.6576	comp 21	2	8.6778
log	20	1.3010			1.3010
		1.9586			1.9788
	90.9		95.2		

6	1666				
	2				
Com	18.66	2 8.7305	comp	17.66	8.7532
comp	16.66	1.2216			1.2216
log		1.9524			1.9748
	89.5	9042	94.8		9496
		802	89.		

7 14.28 — 2 — comp 16.28 — log 14 28 — 87.7

8,7885 — 1,1547 — 1,9432 — 8864 — 77

15.28 — 8,8159 — 1,1547 — 1,9706 — 93.4 — 9412 — 87.3

8 12.5 — 2 — comp 14.5 — 12.5 — 86.2

8,8387 — 1,0969 — 1,9356

13.5 — 8,8697 — 1,0969 — 1,9666 — 92.6

9 11.111 — 2 — comp 12.111 — 11.111 — 84.9

8,8834 — 1,0457 — 1,9291 — 8582 — 72.1

12.11 — 8,9169 — 1,0457 — 1,9626 — 91.7 — 9252 — 84.2

10 10 — 2 — comp 12 — 10 — 83.4

8,9209 — 1, — 1,9209

11 — 8,9587 — 1, — 1,9587 — 90.9

11 9.09 — 2 — comp 11.09 — 9.09 — 82

8,9551 — 1,9585 — 1,9136 — 8272 — 672

10.09 — 8,9961 — 1,9585 — 90.1 — 1,9566 — 9092 — 81.1

12 8.333 — 2 — comp 16.333 — 8.333 — 80.6

8,9859 — 1,9206 — 1,9065 — 8130 — 65

9.333 — 9,0309 — 1,9206 — 89.3 — 1,9508

13 7.6923 — 2 — comp 9.6923 — 7.69 — 79.3

9,0135 — 8859 — 1,8994 — 7988 — 629

8,6923 — 9,0609 — 1,8859 — 88.8 — 1,9468 — 8936 — 783

14 7.14 — 2 — comp 9.14 — 7.14 — 78.8

9,0391 — 8537 — 1,8928 — 7856 — 61

8,14 — 9,0894 — 8537 — 1,9431 — 87.7 — 8862 — 76.9

15 6.66

2 2

comp 8.66 9.0625 7.66 9.7158

6.66 1.8234 .8234

76.9 1.8859 86.9 1.9392

.7718 .8784

59 75.6

16

17 5.88

2 2

comp 7.88 9.1035 6.88 9.1625

5.88 .7693 .7693

74.6 1.8728 85.4 1.9318

18 5.55

2 2

comp 7.55 9.1221 6.55 9.1838

5.55 .7442 .7442

73.5 1.8663 84.7 1.9280

.7326 .8560

54 71.8

16 6.25

2 2

comp 8.25 9.0836 7.25 9.1397

6.25 .7958 .7958

75.7 1.8794 86.2 1.9353

87.66

71.2

20

5

2 2

comp 7. 9.1549 6 9.2219

5 .6989 .6989

1.8538 83.3 1.9208

9 71.4

25

4 2 5

2 2 4

6 9.2219

4 .6020

1.8239 80

66.7

2 9.

.

30 3.333

2

5 333

3 333

2 9.2731

.5228

1.7959 4.333 2 9.3633

.1228

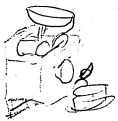
1.8861

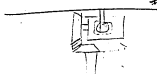
62.5 5918 76.9

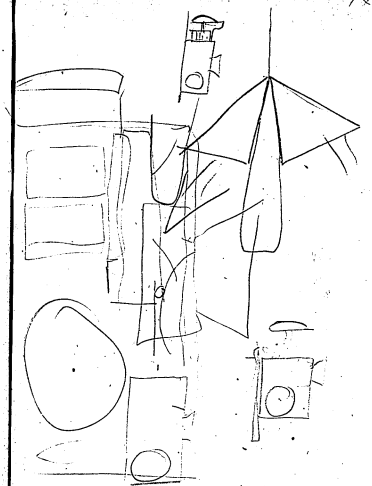
39

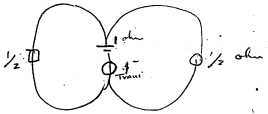
Lamp 100 Ohms
Machine 1 Ohm
Conductor 1/2 Ohms

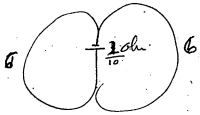
~~200~~
100
1.5
101.5








1 ohm
½ Ω
½ ohm


6
6

1 - $\frac{2}{5}$

$\frac{1}{8}$. $\frac{1}{15}$ of a Daniel Cell

8 ohm total, or $7\frac{1}{2}$ ohms —

1, 2, 3, 4, 5, 6,

$\frac{1}{8}$ of whole

$\frac{1}{64}$ of distance

100°

2 ohm

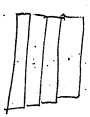
dif $\frac{1}{10}$ ohm dif—

$\frac{1}{5120}$

$\frac{1}{1075}$

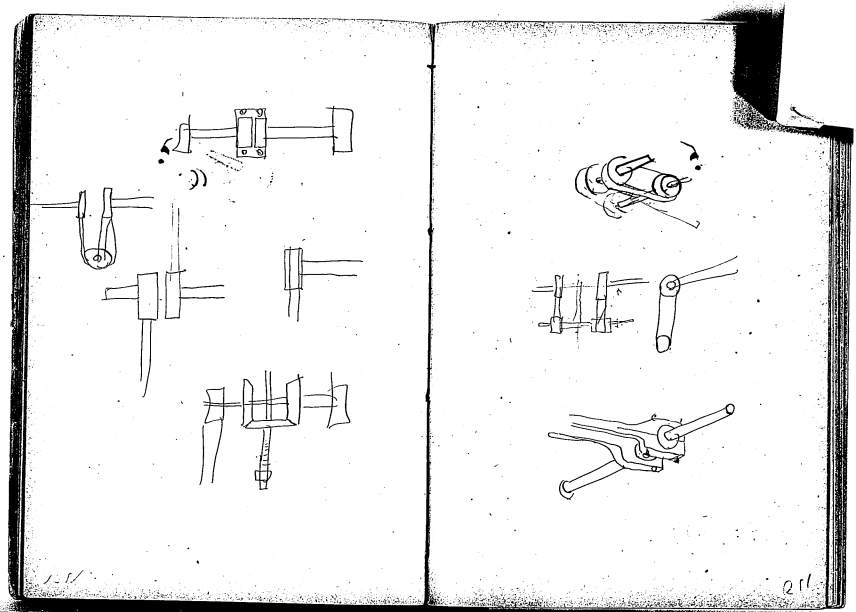
$\frac{1}{140}$

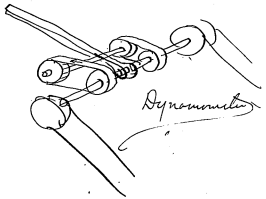
.7 $\frac{1}{70}$.

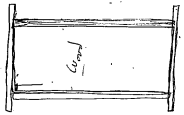


with an inductive coil having
primary of 1 ohm Coil & Bobbin
of 5 ohm Coil and Coil 2
ohms total 8 ohms; there will
be $\frac{1}{8}$ of a Elec. on the whole;
in the coil there will be $\frac{1}{64}$ of
an Elec; as the [illegible] makes
$\frac{1}{10}$ of an ohm diff – the
largest wire; there will be a
difference in forming of
$\frac{1}{5120}$ of an Elec –

	½ ohm coil.	$\frac{1}{8437}$.	3317.
		$\frac{1}{5120}$	diff
Total is.	1 ohm coil		
	2 " "	$\frac{1}{3645}$	1474.
	3 " "	$\frac{1}{3333}$	312
	4 " "	$\frac{1}{3326}$	7 ×
	5 " "	$\frac{1}{3456}$	130. ×
	6 " "	$\frac{1}{3661}$	205. ×



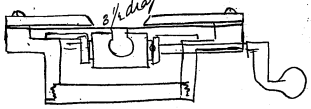

Dynamomètre

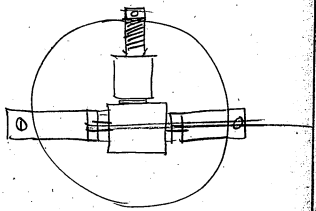


4 layers 23.
6 of 34.
4 " 34.

Edison telephone — July 1st 1879 — 13
Chas Batchelor

3/4 diagl Lam "

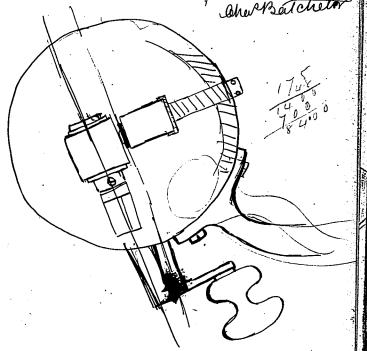




Edison telephone

July 7 1999

chest catheter



160

Chas Batchelor

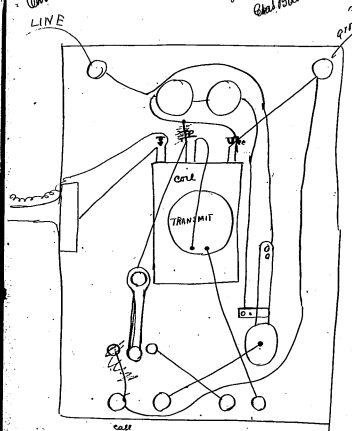
Chas Bal

Edison Telephone

July 4 1879

Chas Batchelor

161



Connections for new design telephone

July 4th 1879

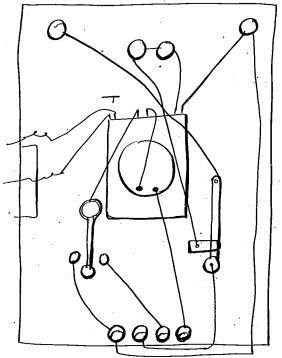
Chas Batchelor

16 carbons — 6¢ 96¢
16 Zincs
Blotting — 4¢
Glass — 15¢
Sulphate
Madden bro
Brassed Hasprings & bro

Ericsson Telephone

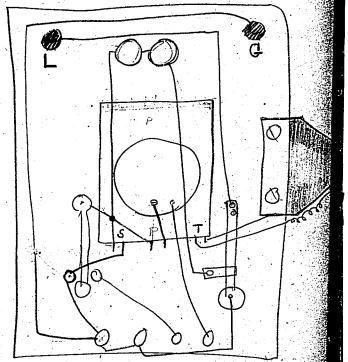
July 7 1919

Characteristics



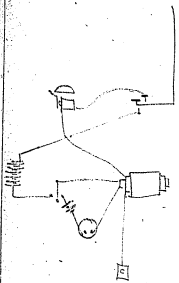
Connections at back so as not to cross one another

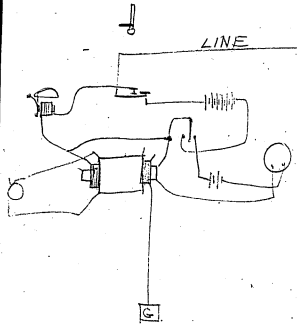
66



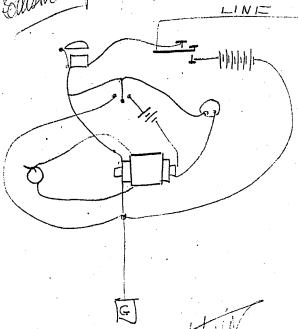
Telephone Connection when cans stay on right side

Eliz. Patchetor

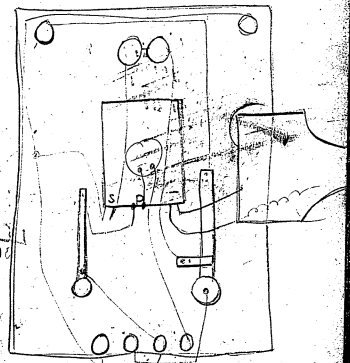

E


LINE
G

Edison telephone. July 9th 1879 77



Chas Batchelor



Power: this is the connection for telephone

278.150 ÷ 1 = 278.49

1823.29 .15 278.15

600 ×11 = 7

32

9 | 39

4/3 27349

20 2/3

20 2/3 e

1823.29 .15 91.1645 182329 27349.35

.00082485 .00076596 .00085889

.0080420856

1.0 × 77.14

278.15) 273.4935 (98

231.6299

31.980

42.7 42.7 2989 854 1708 1823.29

25 2/3

42 2/3

128 1764 6 4 3 4

9.83 26.2 1966 5898 1966 257.546

257.546 1823.29 2061.0368 2575.46 27.514968

10 : .98 1 : .98

Test of the per cent of cu in the wire (sum as .042 . cu.

Test 7 thousands of the Machine wire that was on over

.043 .043 .0425 .042.75 .042.5 .042.5 .042.75 .042.75 .043 .042.5 .043 .043 .042 .043

Res .15 1.764 ft on the

26.2 ft

Lap 1 1/2 + 2 1/3

average Dr 42.4

9.83 × 26.2 × .008

1823.29

257.546 / 1823.29

27.514968 / 1823.29 = 1% / .15 = 98%

Bare wire on Reel

Marked .042

160 ft ohm

.041
.041
.041
.040.5
.041.5
.041.5
.040.5
.040.5
.040.5
.040.5
.041.5
.040.75

R. 31

L. 49.5

Temp 78° F

100% Cu

Dia 41.

41
41
41
164

$\frac{9.83}{1761} \times 49.5 \times 1.09$

$\frac{486.585}{1761} \times 1.09 = \frac{540.38}{1761}$

$\frac{5.40.38}{1761} \times \frac{1}{31} = \frac{540.38}{54591}$

$\frac{983}{1681}$

$\frac{41}{41}$
$\frac{41}{1681}$

$\frac{9.83}{1681} \times 49.5 = \frac{486.585}{1681}$

$\frac{486.585}{1681} \times 1.09 = \frac{530.38}{1681} \times \frac{1}{31}$

52111 | 530.38 (10.1
52111
92700

31

Wire The machine is wound with:

.040·5
.041·
.0 40.5
41.5
41.5
41·
40.5
41
41.5
41·

R.19
L. 30.8
Length 72

40.5
40.5
2025
1620
1640.25 ft²

9.83 / 1640.25 × 30.8 = 302.764 / 1640.25 × 100

30.8
9.83
924
2464
2772
302.764

302.764
100
2722.12
302764
328.98512

328.98512 ÷ 1 = 328.99

16402.25 / 19 = 31164.75

14762.25
1640.25
31164.75

325.99 / 31164.75 = 1/95 = 100%

173500

72
32
9|40

88

77 × 77 = 5929

85 × 85 = 7225

425

44

60/100 (1.85) = 1.85

2890000

2890000

317900.

4

1.3

1.85 | 317900.0 (171911.

210

137

126

119

105

140

105

350

350

0

2

5

6

176611.

2 | 317900.

158950

.75 3/4

.25
1.8

2 18 144 0
7

.25
1.8

.14
1.8

7

176611. ft in all

4

1.8 | 176611.0 (109229.
18 .25
166 546140
162 218456
41 273007.00
36
5
.150
144
6 16

27.307 ft in Mch

$\frac{.14}{1.8}$

3

$$\begin{array}{r} 109228. \\ \times\ .14 \\ \hline 436912 \\ 109228. \\ \hline 15291.92 \end{array}$$

85
3
255

127

85. ∫ 127
85
85 } 127 } 65
85
85 } 65
85
85

32 1/3

16

85
85
85
85 } 32 1/2
85
85
85 } 65

300.

100
100
10000
44
40000
40000
44000000 | 11
400
4000
4000
400
400
00

11
400
4000

34
85
170
272
2890

440

60
85

40
120

35
3
105

34.

32 sevens 8 ones

85
85
225
450
7225
45
28900
28900
108 | 3179.0

45

7

315

3.

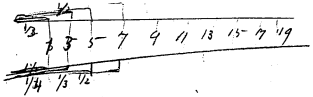
45.

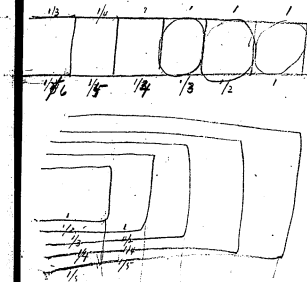
3.

180

42

45

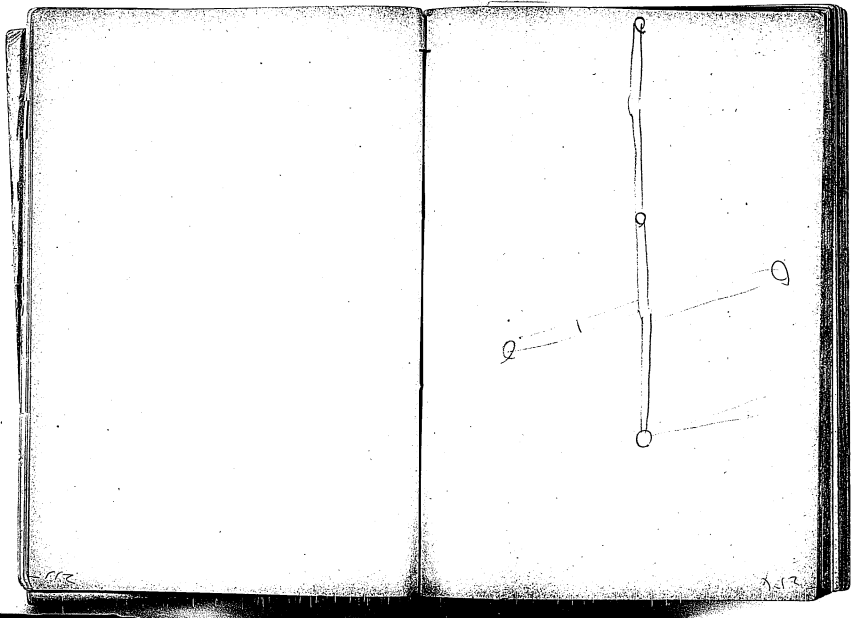


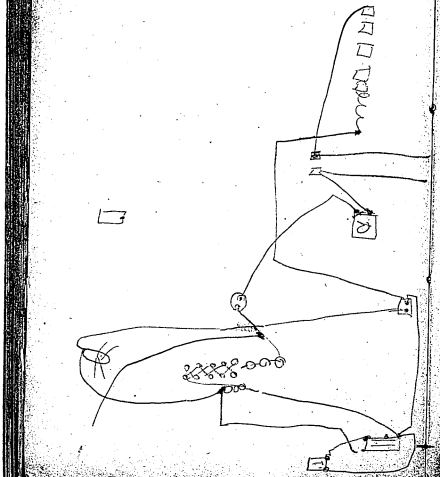

1/3
1/4
1/5
1/6
1/4
1/3
1/2
1
1/2
1/3
1/4
1/5
1/6

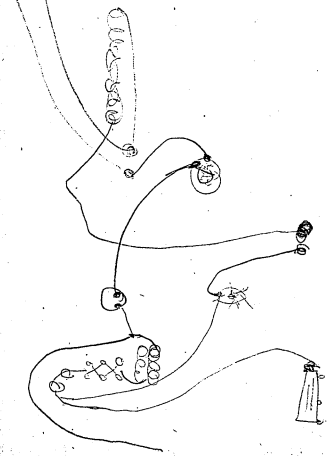
50
50
2500
44
10000
10020
110,070

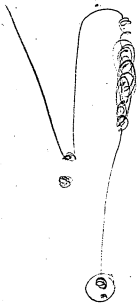
110 000

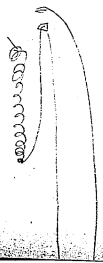
25.00
3
75.00

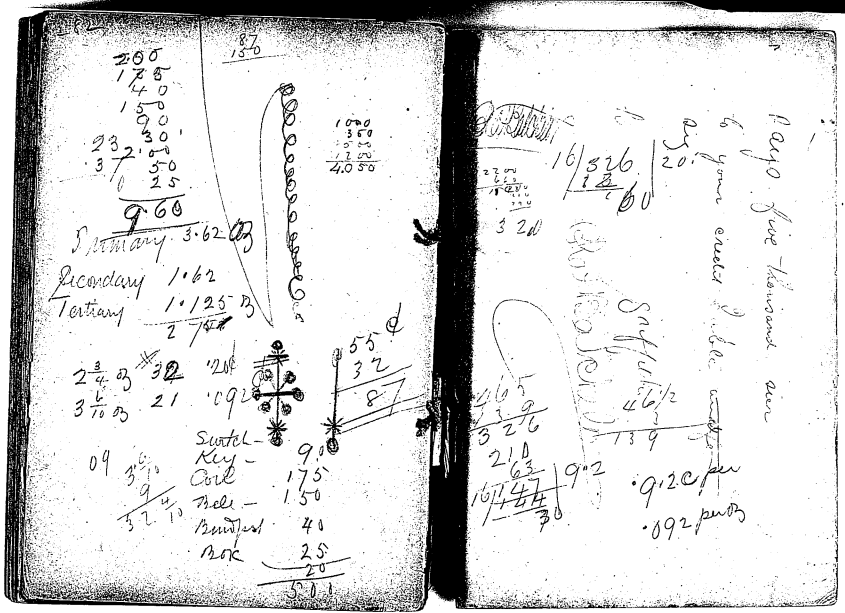












Menlo Park Notebook #39 [N-79-11-21]

This notebook covers the period November 1879-July 1880. Most of the entries are by Francis Upton and relate to electric lighting. There are also notes and drawings by Charles Batchelor on the telephone. The Upton material includes notes, calculations, and drawings of meter tests; tests of bast fibre and other carbon filament lamps; tests of a small motor; and calculations on boilers. The label on the front cover is marked "Meters &c." The book contains 282 numbered pages.

Blank pages not filmed: 4-7, 10-23, 210-211, 250-251, 254-255, 258-259, 262-263, 266-267, 270-271.

No 39
Results Times p 212
Times turned p 214

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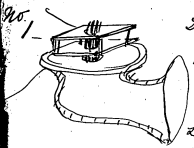
639

Results of experiments tried on Bartelot's telephone.

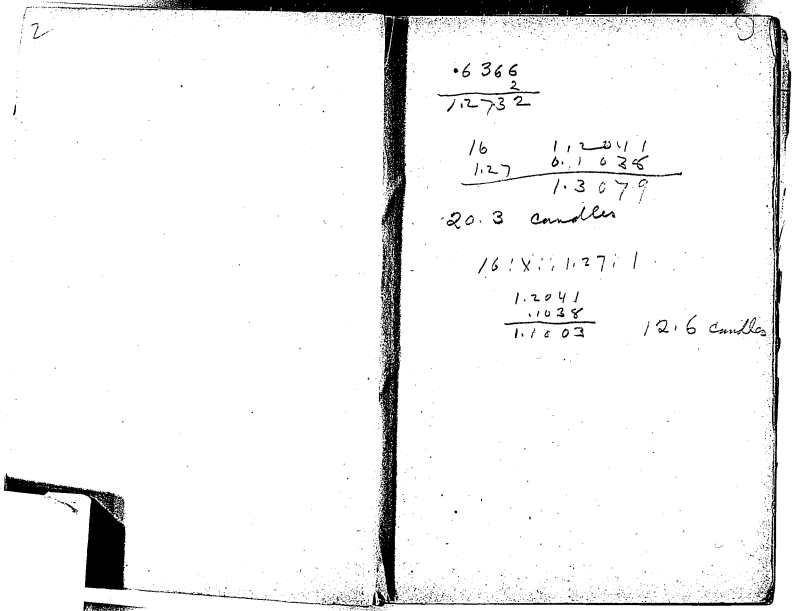
No. 1



Tried this with 66 pins — Articulation not good enough — Lessened the pins to 33 and this made the articulation worse Lessened them to 20 — Worse yet think if we made 500 we should have it perfect

Nov. 21st 1879 Charles Batchelor

Carl Rowland
Battery Jims
Hughes



2

•6366
2
1.2732

16 1.2041
1.27 0.1038
1.3079

20.3 candles

16 : X :: 1.27 : 1

1.2041
.1038
1.1603

12.6 candles

Lawson placed 16 plates 264 hours in a solution of 15 Cu SO_4 and 1 H_2SO_4, irregular amounts of solution used.

Plate 56	Surface	Loss
	16 sq. in	131 mg
	15	116
Both sides of plate	14	112
	13	106
	12	114
	9	87
	6	62
	5	51
	4	37
	3	41
	2	23
	1	20
	10.0	90.0

9 mg. per sq. inch loss in 264 hours

Loss per sq. inch per hour

9	01.9542
264	2.4216
	2.5326

.0.34 mg per hour per sq. inch

Four other plates without apparent reason but by another law

Surface	Loss
11	164
10	152
8	137
7	132
46	585 (127

46 | 585 (127
46
125
92
330

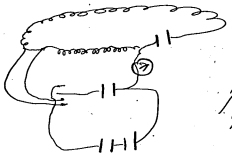
100 900
416 585
146 1485

3.1643
2.1613
1.0030
2.1216
3.1514

all the plates combined
.038 mg. per hour

Experiments with meters

Measure the polarization when a full current is passed through by means of the opposition method



Batteries Nov June 8 33

1	259 L	261 R
2	259 L	261 R
3	259 L	261
4	259 L	261 R
5	259 L	

5	59.5 L	60 R
+ 4	119 L	120 R
+ 3	179.75 L	179.75 R
+ 2	239	240
+ 1	299	301

1.09
4.32

3

June 8

31.1 Ohms in resistance box Temp. 68.67

This is the lower box for use in plating experiments

4 cells of Daniells

332 L 335 R

1-55 P.M. Started

2-00 144 L 145 R

around 31.1 Ohms

6.5 L 6.5 R around 5-9 Lawrence

2-07 146.5 L 145 R

2-10 145.5 145 R

2-15 146 L 145 R

4 cells

332.5 L 335 R

June 8

2-20 136 L 145 R

225 Stopped

Temp. 69.5 ~ 7 of falling

Plates No 9 Lawsons

5 0.583 grammes 9 grains

5 7.73 grammes 11.3 grains

10 8.313

Last Wt Book 48 page 266

5 7.740 grammes

5 0.650

Plates 8 5 6.335

Before 5 5.175

after 5 6 grammes 5 grains

5 5.972 15

not enough

38

$\frac{297}{101} \times 1.08 \times 20 =$ Volts

1.08
20
21.6 — 1.3345
2589 — 0.4609
1.7954
62.4 / 31.2 — 1.4955 — Taken this day
.2999
2

1.3757 | 2.1387
comp 35 | 8.4559
9.7001
1.2943

2 Webers
19.7 mgs. per minute

Stopped 4-17

---

101 | 290 | 19
2900

8 Volts / 35 — June 8 — 39

20 cells 100

3-42 O.M. Started

290 L — 290 R
287 L

20 cells
100 L — 101 R

293 L
290 R

Coil heated about 10° F

293 L
290 R
290 R
292 L

293 L
290 R
295 L
290 R

R 290
L 295

56.9315
55.595
1.3365
2.42
1.361
1.359
.2750
1.375

56.324
54.907
1.414
25
1.389

64,000 Ohms in line with galvanometer

104 on 9.03 Ohms
5 on meter

Lawrence Electric Before Bookstaber 266

(10) after 56.9315 — 55.595
54.259 — 55.735
111.1905 — 111.1250
.0595 — 111.1905
.0247

(8) 54.907 — 56.324
56.4617 — 55.097
111.3687 — 111.421
111.368
.0533
25

42

163
52
215 2.
1.4
2.29 2 Volts
20 | 11.4
5.7

52
5.7
46.3

210.5
71
781.5
16
40 | 29.15
7.44

71
7.44
6356

68.5 : 210.5 :: 46.3 :

2.3042
1.8356
8.1978
2.1676 146

71 : 210.5 :: 52 : 185

52 1.7160
210.5 2.3042
8.1487
185 2.2689

June 5 43

One cell of battery [illegible]
through 1.01 Ohms
and cell

216 ~~#~~ around 1.01
67 around cell

2 cells

~~146~~
163 around 1.01
52 around cell

1 cell

210.5 around 101
71 around cell

830 mg

4Ω | 83Ω
20.75

1.3170
0104
20.2 mg 1.3066

141.5
139
280.5

2Ω | 28Ω.

209. comp 14 8.8539
205
414 1.079 0.0330
414 2.6170
higher Temp. comp 31.15 8.5065
.0104

209
25 C
122

1 Weber 20.2 mg per minute
resistance of coil taken as 31.15Ω
Page 38
2 Webers 19.7 mg per minute
resistance of coil taken as 31.3 Ohms

June 9 1880

20 cells
141.5 L cells 139 R
10-6 Started
210 L 207 R
20 cells 31.1 Ohms
141 L 139 R
10-10
209 L 207 R
10-20 210 R
10-25 210 L
10-45 208 L 201 R
10-46 Stopped

(8)

55.737
34.907
.830

55.632
111369
111.3687
.0003

56.6407
55.737
.7247

(10)

56.9315
55.089
.8425

56.097
111.1816
111.1805
.0045

55.089
54.259
830

Plates 9 were in the circuit with a taller battery six hours

(9)

63.777

44.599
108,376
108.313
.063

Loss

page 47

June 9, 1880

If less deflection ~~was~~ obtained by any cause at galva. than expected, Ratings

or absolute value taken as too small, too little work done. Probably. Or Profs Ayrton & Perry took absolute ~~is~~ too small

63.5 deposited by one Weber

58

19 Webers

200
198
199

Webers	19	1.2788
	199	2.2959
		2.9799

.095 ,1 cell
.190 Webers
61 1.7853
26.7 1.4099
.3754

Ratio 2.37

June 9, 1880.

4 Plates 2 7/16 X 4"

5% Lawson's solution

Bichromate Kll 208 = D
198 R

10 Ohms in circuit

Resistance 10 Ohm

Battery poles 192 R
194 L

Galva. around 1 Ohm
100 to a Volt
20.5 L
17 R

Zero made good 18 R
20 L

Galva shunt = ∞
62 L
60 R

32

.26 Weber

26.5 1.4232
198. 7.7033
2 0.3010
9.4275 — 8.0042

85.75 1.9332
33.5 1.5250
.4082

Ratio 2.56

June 9. 1880.

33

Around Circuit

Shunt ∞ 24.5 R
24.5
27
51.5
25.75 27 L
24.5 R

7 Ohms beside meter in circuit

Shunt ∞
around deposition.
32 R
35 L 33.5

Around 1 Ohm
Shunt ∞ 85 R
86.5 L 85.75

Shunt 28 L
100 Volt 25 R 26.5

54 .42 Weber

41.75 1.6206
8.0043
9.6249

137.5 2.1383
49.75 1.6968
.4415

Ratio 2.76

Bichromate June 9 1880 17

195 R
195 L

4 Ohms in circuit besides deposition

Around 1 Ohm

43 L
40.5 R

43
40.5
835
41.75

Shunt ∞ 136 R
139 L
137.5

Around deposition cell

Shunt ∞ 51 L
48.5 R
995
49.75

199.5 2.3000
58.75 1.7689
Ratio 340 .5311

1 Ohms 9 inches per cell

Around depositing cell

Shunt ∞ 118 R
120 L

Around 1 Ohm

New Shunt 199 R
200 L

Around deposition cell

New Shunt 60 L
57.5 R
117.5
58.75

.1925 Webers

June 9

Meter on shunt

Shunt .114 Ohms

Wire 4.1 Ohms

Bichromate cell

200 L 200 R

Around 1 Ohm

21 L 17.5 R

17.5

38.5

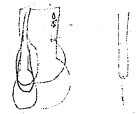
19.25

30.25 : 296.5 :: .114

T. 0569
2. 4720
8. 5193
0.0482

1.111 Ohms in boxes if shunt has .114 Ohms

29.75 : 297 dc



June 9

Deflection around one Ohm made

294 L 300 R
292 L 293
586
2965

around shunt A

32.5 L 28 R
32.5 L 32.5
65
3025

Around the Ohm

3 P.M. 296 L 298 R

around Shunt A

31 L 28.5 R

31
28.5
59.5
29.75

Shunt B around A

43 L 40 R

around B

22 L 18.5 R

all shaken no difference

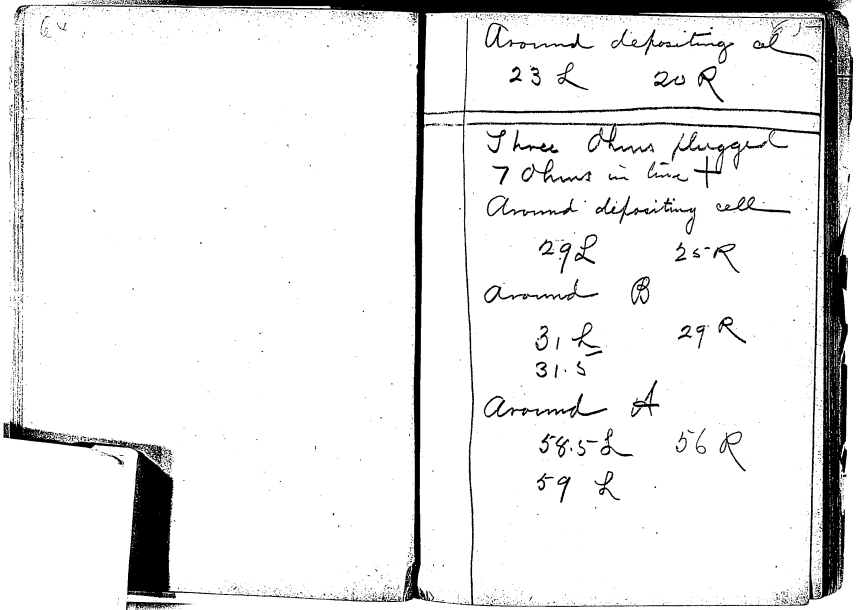
12

3-9 June 9 Around deposition cell ES
16 L 15 R
Around shunt A
44 L 40 R
Around B
25 L 20 R
Around deposition cell
22 L
23 L 20 R

3-17 Around A
43 L 40 R

3-22 43 L
Around B

3-24 25 L 19 R



Around depositing cell
23 L 20 R

Three Ohms plugged
7 Ohms in line +
Around depositing cell
29 L 25 R
Around B
31 L
31.5 29 R
Around A
58.5 L 56 R
59 L

another 3 Ohm plug

4 Ohms +

3-35 around A

96 L 96 R

Around B

61 L 60 R

Around depositing cell

34 L 32 R

3-38 3 Ohm across

~~7 Ohms +~~

3-39 29 L ~~27 R~~

around shunt A

59 L 56 R

4 Ohms
Around A

95.5 L 95 R

Around B

63 L 59.5 R

Around depositing cell

3-45 34 L 32 R

Battery

197 L 198 R

3-49 Around 1 Ohm

56 L 45 R

46 L

195 L

3-55 196 L

3-57 198.5 L 199.5 R

June 9 1880

Around one Ohm before making connection

4 –	46.5 L	43.5 R
	Around the shunt A	
4-4	96 L	94 R
	Around B	
	60 L	60 R
	around cell	
	36 L	34 R
	12 L from cell current broken as this is E. M. F of cell	
4-10	P&S R.	
	11.5 L	8.5 R

4 Ohms June 9 1880

Around cell

29 L 34 R
37 L
38

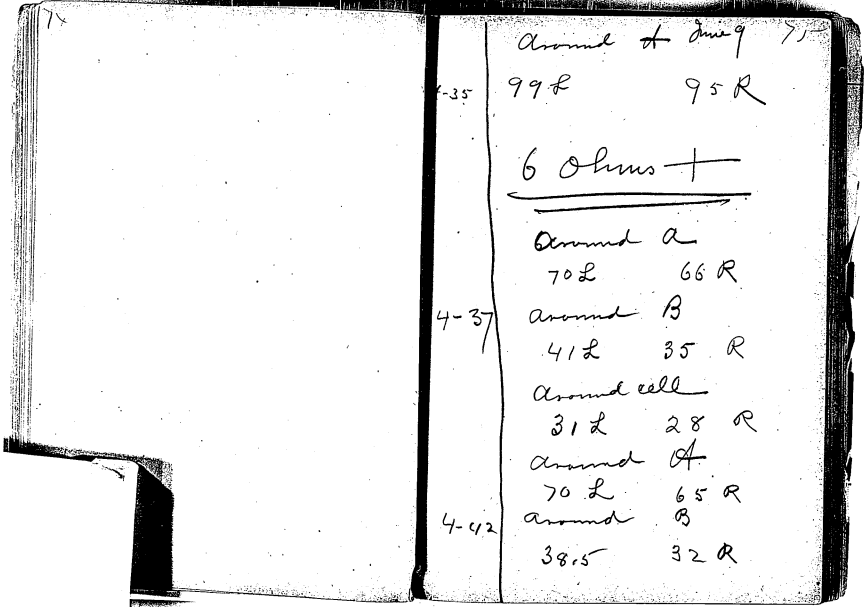
Circuit broken

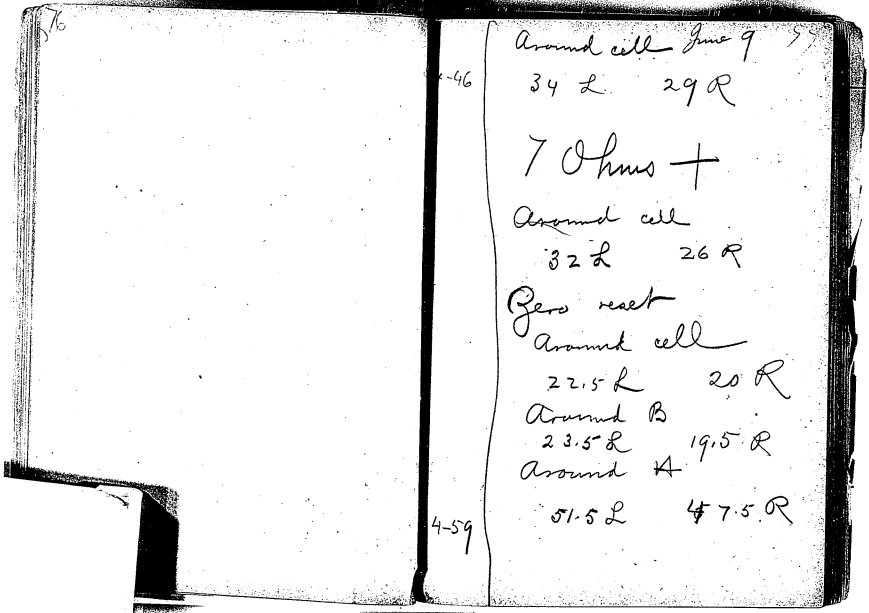
immediately	20 L
	15 L
15 sec	14 R
30	12 L
1 min	9 R
2 m	12 L
4 m	10

36 L 35 R
37 L

Around B

430 61.5 L 59 R


around A
99 L 95 R
6 Ohms +
around a
70 L 66 R
around B
41 L 35 R
around cell
31 L 28 R
around A
70 L 65 R
around B
38.5 32 R


76
Around cell June 9 57
4-46
34 L 29 R
7 Ohms +
Around cell
32 L 26 R
Zero reset
Around cell
22.5 L 20 R
Around B
23.5 L 19.5 R
Around A
51.5 L 47.5 R
4-59

Around R June 9 1880

25 L 20 R

Around cell

29 L 23 R

Reversed poles of battery

After one minute around the cell

20 L 18 R

Around B

36 L 38 R

Around A

55 L 54 R

Around cell

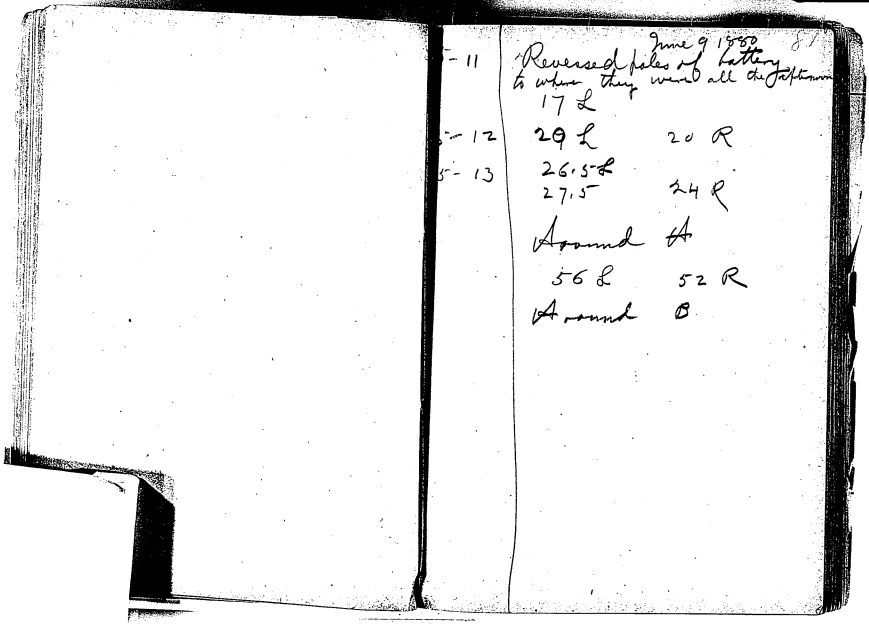
24 R 21 R

3 Ohm plug left in

30 L

Taken out 24 L 22 R

5-7



- 11
- 12
- 13

June 9 1588

Reversed poles of battery
to where they were all the afternoon

17 L

29 L 20 R

26.5 L
27.5 24 R

Around A

56 L 52 R

Around B

~~I wall~~

Boxes wound with German silver
Fitted with two cells in multiple
are run up the scale of
current with a depositing cell
direct in the current
From ratio make out resistance
and E.M.F. of cell

Run up a cell on a
shunt and down in-
creasing and decreasing the
current gradually but always
in same way to imitate
practice

Temp German silver coils
66.5 F
Resistance 31.10 Ohms

9-15 1 Weber of current
9-20 31.15 Ohms
2 Webers 31.3 Ohms
9-35 3 Webers 31.5 Ohms
4 Webers 31.7 Ohms
Temp thermometer laying on coils 80° F
coils warm to the hand

June 10

Cooling of coil

9.47	31.77 R
9.475	31.3 R
9.48	31.3 R
9.485	31.25 R
9.49	31.22 R

3 Ohm box wound with German silver wire
8.8 Ohms

2.1384
192 to a Volt

30 1.47711
amp 192 7.7167
amp 1.08 9.9666
1.1604 — 7.6833 — .744 Weber

447 2.65033
383 2.58332
.0671 — 1.17 Ratio
2
2.34

Shunt W 192 to a Volt with weight arm.

Shunt X $\frac{585}{40}$ X 192 = 2810 to a Volt

2.7672
2.2833
8.3979
3.4484

Shunt X
2810 X 1.08 = Deflection for one Weber
around B

3.4484 = 3030
0.633X
3.4818

June 10

Test of Electromotive force of depositing cells.

Bichromate
187 L — 200 R
188.5 L — 195 R
190 L — 194 R
190 L — 194 R

Bichromate circuit open
2-10 190 L — 194 R — 190 / 194 / 384
12 ohms in 1 unit
around
Shunt X
B 1.08 Ohm
Weber
A deposition
16 L — 13 R

40 1.6021
7.6833
9.2854 .193 Webers

585 2.7672
467 2.6693
.0979 1.25 Ratio
2
2.50

447 2.6503
3020 3.4818
9.1685 .197 Webers

383 2.5832
2810 3.4484
9.1348 .186
.068

585 2.7672
2.4818
9.2854 .193 Webers

467 2.6693
3.4484
9.2209 .166
.083 Volts

Around B June 10 57

15 R 15 R
15 L 14 R

Shunt X
made around B

222 L 225 R
222
447

Around A

189 L 194 R
184
383

9 Ohms in circuit

Shunt X
Around A

233 L 235 R
232
Around B 467

290 L 295 R
290
585

55.5 1.7443
7.6833
9.4276. .267 Weber

306 2.4857
221 2.3444
.1413 1.39/2 Ratio
2.78

305/55.5 X192
1.4800
2.2833
8.2557
3.0790 1045 to a Volt
10 61 page 96
2106
1053 to a Volt

360 2.5563
Comp. 306 7.5143
.267 9.4276
9.4982 .315 Webers

360 2.5563
259 2.413 7
.1430 259 2.413
3.022
9.3905
1.39/2 (246 .122
2.78

306 2.4857
1053 3.0225
.290 Volts 9.4632
.264 Volts 8.0334
9.4228 2.9891

221 2.3444
3.0225
9.3219
.1210
.105 Volts

Shunt W around 10 B
21 L 19 R 40
6 Ohms + in line

Shunt W
2-31 29 L 26.5 R
29
555

Shunt Y 15-5 L 15-1 R 155/155/306
Around coil A
111 L 110 R 111/110/221
5 Ohms in line

Shunt-Y
2-40 131 L 128 R
13
Around B259
181 L 180 R
179 R 360

96

417 2.6201
comp 360 7.4437
9.4982
9.5620 .365

417 2.6201
290 2.4624
.1577 1.44 Ratio
2
2.88

2.4624
3.0225
9.4309
30.10
9.1299 .134 volts

435 2.6385
comp 417 7.3798
9.5620
9.5804 .381

comp 306 9.4276
7.5143
435 2.6385
9.5804

435 2.6385
299 2.4757
.1628 1.45
2
2.90

97

2-45 4½ Ohms gmx 40
around B
206 L 211 R
206
417
around A
146 L 145 R
145 R
290

4 Ohms +
around A
150 L 150 R
148.5
150
149
299

2-50 around B
215 L 220 R
435

6 Ohm +
around B
152 L 150 R
around A
116 L 115 R

96

page 99

2 | 264.5

192.2

107 2.0294
192.2 2.2833
108 7.7167
9.9666
9.7127 .516

295.5 2.4705
192 2.2833
1.872 1.872

154
2
.308

Shunt Y 591/107 X 192 1061 to Volt

2.7716
2.2833
7.9706
3.0255

.133 2.1239
107 7.9706
9.7127
.9807 2 .642

2.7658
108 0.0334
2.7324
2.6117
.8783

404 2.6064
251.5 2.4005
.2059

1.60
2
3,20

Shunt Z 404/1332 X 192

2.6064
2.2833
7.8761
2.7558

3.7 Volt

Shunt Y 30 hms + gnd to around cell

192 L 192 R

192
384

Around B

294 L

297 R

591

S. Shunt W

3 — 57 L 50 R 50/57/107

2' Ohms +

70 L 63 R 133

Shunt Z around B

206 L 202 R

208 L 202 R 202/207/409

Around A

130 L 121 R

122 R

130
121.5
251.5

505
404 6442
160
.1802 Webers

505 2.7033
310 2.4983
.2250

1.652
.3376

210.5 2.3232
192.2 7.7162
10.8 9.9666
.0061 1.101

370 2.5682
210.5 2.3232
.2450 1.762
3.512

1½ Ohms + around A June 10

152 L 158.8 R
152
310

Around B

255 L 250 R
237.5
505

1 Ohms +

325.5 L 327 R
327.5
652.5

Shunt W

110 L 102 R
109 L 100 R 101
109.5
210.5

Shunt 3 400 Ohms Around A

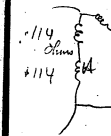
188 L 182 R
188
370

Zero 6 L

Cell

Shunt W 195 L 189 R
194 L 191 R
190
194.5
384.5

2 Shunts and cell



3-40 Bichromate cell

191 L 190 R

192 L

190
191.5
381.5

12 Ohms in line

3-5-5 192 L

No diffection from cells direct on galva-

Around 1 Ohm

20 L 10 R

On shunt

5 L

7 7.2 R

114
114
·228

1525 : 710 :: ·228 : x

2·85 13
1·35 79
7·81 67
0·02 59

1.06 Ohms

New Shunt around A

80 L 72 R 80.5 / 72 / 152.5
81 L

around B

51.5 L 43 R

around C

36 L / 87.5 26 R / 69

around A

83 L 75 R

9 Ohms in line A

105 L 100 R
99 R

12 Ohms in circuit

around 1.05 Ohms

360 L 360 R / 350 / 710

9 Ohms June 10 10

4-10

Around B

69 L 63 R

70 L

Around C

41 L 34 R

Around A

105 L 102 R

6 Ohms + Around A

4-10

149 L 149 R

149 R

Around B

107 L 102 R

Around C

47 L 45 R

104:482::228

7.3579
2.6830
7.9830
1.0239

1.05 Ohms

4 Ohms

Shunts around C

56 L 55 R

around B

171 L 172 R

around A

215 L 215 R

New Shunt around A

53 L 51 R

around 1.008 ohms

240 L 240 R 240
239 L 243 R 242
482

Shunt W 47 L 41 R

46 L 41 R

4-45 around battery circuit broken

190 L 190 R

165

3 Ohms + June 10 1909

Battery

306 L 308 R

On 1.08 Ohms

89 L 85 R

Shunt ∞

On Shunt A

4.55

272 L 271 R

on B

212 L 210 R

on C

66 L 62.5 R

2 Ohm +

on C

78 L 75. R

on A

off L R

on B

325 L 325 R

116

1 ohm June 10

Shunt 3000 on A

310 L 320 R

on B

272 L 275 R

on C

5-7 48 L 42 R

42 R

1.15 ohm

B. A. Resistance Coil

Shunt galva = ∞

1 Ohm
179 R
184 L
367

2 Ohms
355 L
352 R
707

367
2
734

2 Ohms
352 R
350 L
702

10-12

188 L
175 R
363

240 Ohms in circuit with [illegible] battery

June 11

1 Ohm	14 R 27 L 41		
2 Ohms	46 L 32 R 78	78 41 37	
3 Ohms	51 R 65 L 116	116 78 38	
4 Ohms	82 L 70 R 152	152 116 36	
5 Ohms	87 R 99 L 186	186 152 34	
6 Ohms	119 L 105 R 224	224 186 38	
7 Ohms	125 R 137 L 262	262 224 38	

10-20

8 Ohms
155 L
140 R
295

295
262
33

1 Ohm
15 R
28 L
43

9 Ohms
171 L
160 R
331

331
295
36

10 Ohms
178 R
188 L
366

366
331
35

10 Ohms in one plug
188 L
178
366

37

8 Ohms
150 R
148 L
298

10-40

10 Ohms
185 L
182 R
367

118

354.7 2.5498
349 2.5428
.0070

101.5 ohms

20 ohms in circuit 2 wire "15.

10-42

1 Ohm in box

178 L	175 L
169 R	165 R
347	350

The deflection around the multiple arc of three boxes

175 R	180 L
180 L	175 R
355	355

Temp 72° F

1 Ohm in resistance box

175 R	349
175 L	
350	

Om multiple arc

172
172
354

706 : 155 :: 1.0 : P

.0070
2.1903
7.1512
9.3985 comp Log 515

.223
.1115

155 2.1903

page 124 comp

155 2.1903

comp
Volt
at extremities

8.3 .9191
4.7924

to give Meters
and B

Comp .666 1.8195

Shunt ratio
1/87.4

.9085
1.9414

Bichromate 2 one "cell open
2 Volts

315 R
300 L

615
1 Volt = 307.5

12 Ohms + in circuit
On 1 Ohm +

19 R
30 L

Shunt = ∞ assumed Galva.

11-7

352 L
354 R
706

Page 101 See for diagram

On A	78 L		153
	75 R		157
	153		310
On B	32 R		155
	35 L		90
	67	67	65
		65	
On C	42 R	66	67
	48 L		90
	90		157

1.2 215 2.3385
Comp 835 7.0782
.261 Weber 9.4167

107. 2.0294
5.5076
.00394 7.5470
1 9.4167
75.8 1.8797

300 2.4771
7.0782
.359 9.5553

180 2.2553
5.5076
.00558 7.7629
1 9.5553
62 1.7924

9 Ohms + in line

On C	56 L		215
	55 R		111
	111		326
On A	106 R		215
	109 L		221
	215		436
			218
11-15 On B	57 L		110
	53 R		111
	110		221
On B	54 R		
	55 L		
	109		

6 Ohms + in line

On B	90 L	
	90 R	
	180	180
		120
On C	60 L	300
	60 R	
	120	
11-26 On A	152 R	
	148	
	300	

448 2.6513
7.0752
Weber .536 9.7265
380 2.4482
5.8976
7.9548
100901 9.9955
1 1.7747
59.5

583 2.7657
Webers .698 7.8782
380 9.8939
2.8911
.01125 5.0515
6.9426
1 9.9439
55.6 1.7952

402 2.6042
183 2.2853
219 3186
502 2.7534
402 2.6042
1,04 1532

85 2.1615
85 comp 3075 7.5122
170 170 2.2304
comp .0017 9.9930
Webers .544 9.7356

.572 2.7574
comp .545 0.2644
comp .228 10.6424
3-6639

105Z to one Weber
3.0218

Ohmst 00,4610. = 1 Volt on A

4 Ohms + in line

On A	2202	402	402
	222R	455	455
	442	897	897
		948	948
On B	145R	402	402
	141 Z	167	167
	286	225	225
		560	560
On C	80R	280	280
	87 Z	266	266
	167	167	167
		455	455

2 Ohms + in line

On C	88R	193	193
	85 Z	402	402
	193	595	595
		376	376
On A	283 Z	283	283
	288R	289	289
	290R	572	572
		595	595
		1167	1167
		568	568
On B	205R	402	402
	197 Z	328	328
	402	768	768
		390	390

around 1 Ohm + Temp 79°

3 Ohms in
852
85R
770

	219	2.34041
Amt		10.7944
1 Weber	320	2.5048
		10.65515
1 Volt	1430	3.1563
	8.3	.91971
Weber	111.900	4.07754
	256	2.40882
comp	320	7.54752
.180 Webers		9.95634
	184	2.26448
comp	11900	5.92746
	.0154	8.18894
		7.99274
1		1.71140
517		1

184	2.26448	256 2.40882
72	1.85773	184 2.26455
2.55	.40675	139 .14434

June 11 '27

2000 Ohms in shunt

3 Ohms in line compare with last

On A 110 R 219
109 R

2 1/2 Ohms in in line

On A 128 R 129 R
128 R 126 R
256 255

on B 92 R
92 R
184

on C Temp 77° 184
37 R 72
35 R 256
72

3.02.5 2.4807
7.4952
Helen .946 9.9759
2:2 2.3483
5.9246
.0187 8.2729
9.9759
1.7030
1/60.4

388 2.5888
7.4952
1.21 .0840
304 2.4829
5.9246
.0255 8.4075
.0840
1.6765
1/47.5

June 11

2 Ohms + in line

On C 40 R
39 L
40 R
79

On B 115 L
116 R
231

79
231
300

302.5

C 155 R
150 L
305

1 1/2 Ohms +

On A 192 L
198 R
390

386

B 150 L
152 R
302

C 42 L
42 R
84
302
386

530 2724
7.4953
Weber 1.6550 .2495

432 2 635
5.92.46
8.56.01
.2195
1.6494

10363
1
44.6

1 Ohm +

2 mm " 131

on C
50 R
48 L
98

on B
220 R
214 L
434

434
98
532
53

on A
262 L
266 R
528
530

5 turns W on 1 Ohm +

235 R
200 L

Zero 18 R

June 1 13

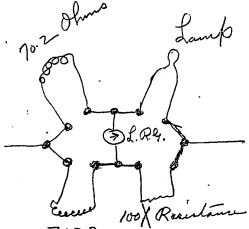
On 1 Ohm in ~~box~~ multiple

185 R
173 L
358

10 ohm in box

180 R
168 L
348

Lamps in bridge June 11 '3



7020 100 X Resistance of Lamp

Less risk, to take

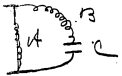
14040 200 X Resistance of Lamp

1500
1500
2400
6300
12600 in W.U. Box

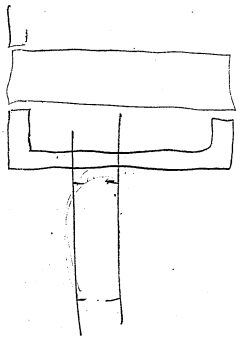
14040
12640
1400

12220 Ohms in B.A Box

12640
6320
6240



Mesh

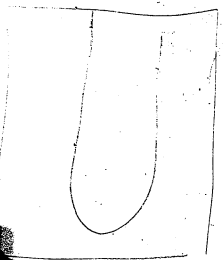


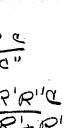
$R'' = \frac{R\,C}{C''}$ $\quad C'' = \frac{R\,C}{R''}$

$C'' = \frac{R'R''C}{R'+R''} \times \frac{1}{R''} = \frac{R'}{R'+R''}\,C$

$C' = \frac{R''}{R'+R''}\,C$

$\frac{A}{A+X}\,C$





$B + C = X$

$A -$

Current through B

Total resist = ...

$C_m = C_m' + C_m''$

$\frac{1}{R} = \frac{1}{R'} + \frac{1}{R''} = \frac{R'+R''}{R'R''}$

$R = \frac{R'R''}{R'+R''}$

$\frac{1}{R'} : \frac{1}{R''} :: C' : C''$ $\quad \frac{\frac{1}{R'}}{\frac{1}{R''}} = \frac{C'}{C''}$

$\frac{1}{R'} + \frac{1}{R''} : \frac{1}{R''} :: C' + C'' : C''$

$:: C : C''$

$\frac{1}{R} : \frac{1}{R''}$

$R'' : R :: C : C''$

$R' : R :: C : C'$

$\frac{\mathcal{E}}{14+x}$ Q

$\frac{\mathcal{E}-\mathcal{E}'}{R}$ = current

$\mathcal{E}' = f(\mathcal{E}R)$

~~$\mathcal{E}' = f(\mathcal{E}R)$~~

The contrary E.M.F. depends on the E.M.F. at the extremities of the line and the resistance in the line

However you get the E.M.F. E.M.F.

E.M.F.

$\frac{33000}{8} = W$ $R = 100$

$W = \frac{\mathcal{E}^2}{R}$ $443 = \frac{C^2}{100} 44.3$

$\frac{33000}{8} = C^2 44.3$

$\frac{33000}{8 \times 44.3} = C^2$

2.51855
8.35536
9.09969
9.96990

.931 Webers

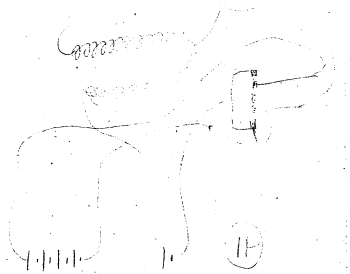
.0310
1.0730 Ohms in shunt to give volt

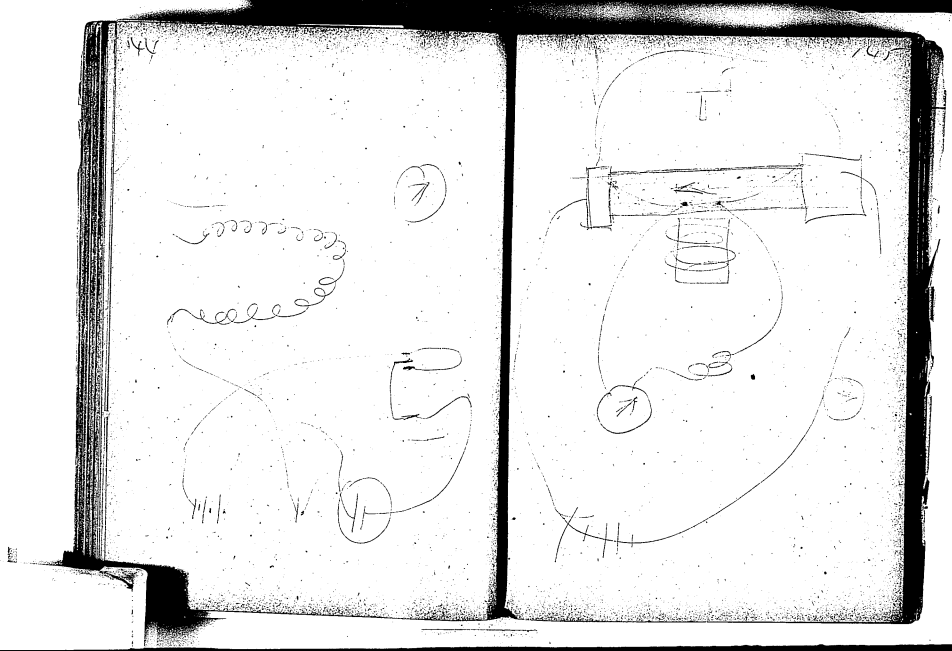
Can afford to lose 1% on meter 100 Ohm lamps
5 lamps 20. Ohms
.020 Ohm in shunt

143

Spacing 9 known

$\mathcal{E}$ constant
R Variable
$\mathcal{E}$





$$\frac{\vartheta_5}{qr-ps} = \frac{\vartheta}{(r+p+q)(q+s+q)-q^2}$$

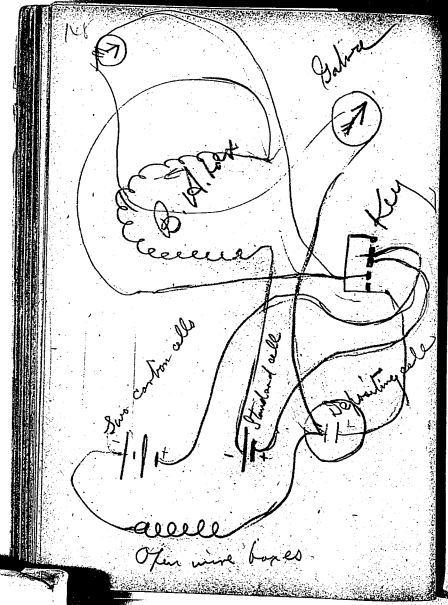
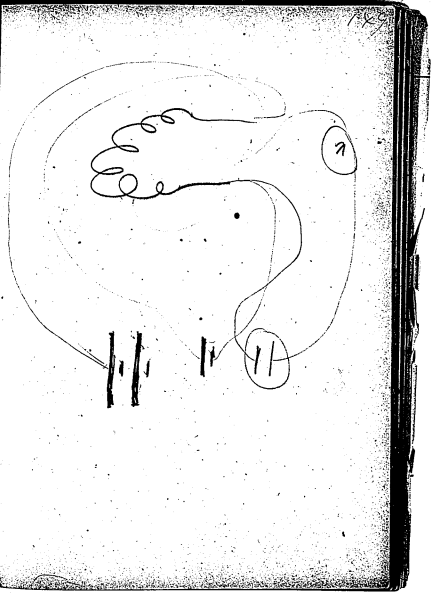
$$\frac{\vartheta_5}{\vartheta} = \frac{qr-ps}{(r+p+q)(q+s+q)-q^2}$$

q and r at pleasure

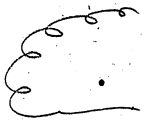
$\vartheta = \infty$ will fullfill this

or

$\vartheta_5 = 0$.


Galvo
Key
Two cadmium cells
Standard cell
Reversing pole
Other mine boxes


170



163)800 (4.9 ct
652
1480

151

190 mg 2 clamps Pump

18 air mg

190)29000 (152.
190
1000
950
500
380
1200
1140
600
570
30

152)5.00 (5.1 ml
760
400

190)31103 (163.
990
1210
1140
703

192

1.08
1.6
6 48
10 8
17.28
5
86.40

17.2
3
51.6

17.28 Volts

10
730+15 Daniells polarization

Daniells Thumbstop 270 = 2

15
270 on cell

27
270 on cell

½ Volt from wrought iron new magnet

5 | 335
67 Volts

3 | 210 Strong field
70 Volts

Small wrought iron Motor 155
235 Main current Speed 1620 r.p.m.
47 around magnet
Ratio main to magnet

47/235 16 cells 0·2

~~5 Volts~~ armature 10·2
~~3 ½ Volts~~

Main line Bank 32 to 78 lags

Magnet	Volts	Armature Volts
47/235 of 62	4.12	34 10·2
97	6.47	42.3 12·7
115	7.61	47.3 14·2
131	8.73	50.6 15·2
162	10.8	56.3 16·9
178	11.9	59.6 17·9
226	15.2	67.6 19·0

Volts

116 280 18.6 67 201 67.

16 cells 31 Volts 216 72.

on line 280 31 Volts

16 cells 52 R

Very strong 7 222 74.

280	2.4472
Comp 31	8.5086
p. 152 17.28	1.2370
	2.1928
	8.8239
	1.0167
Eq 3	0.4771
	1.4938

20 Volts

400	26020
44.3	1.6464
6.8	9.1675
	3.4159

2600 ft. lbs. on magnet to saturate

4	51 85
3.41	5-9
	.0026

12.7 magnets per H.P.

Cu. Cell

10 / 730+15 polarization

Daniells 272 = D

30 / 272 on cell

10-30 145 / 272 on cell

10 / 350+15 polarization

10-35 72 / 272 Daniells on cell

10 / 615 polarization after current had passed a long time through

160

16 cccc = 5 / def
Defon Line 95

80
66
14
8

1·1461 (2)
2·2922

1·8195 (2)
3·6390
2·2922
1·3468

22.2 (2)
44.4

65.5
14.5
548

1·8182 (2)
1·1614
1·3096

204 (2)
40.8

161

80
64.75
1525

1·1832 (2)
23664

1·8112 (2)
3·6224
2·3664
1·2560

18 (2)
36

7 165

2/10

No 1145

Lamps 163 Ohms cold
very high the same

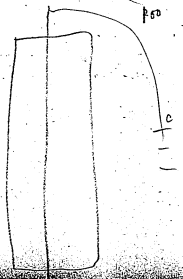
No. 1164

180 Ohms Cold

Busted

168 Ohms cold

169 "



June 22 1880

Running free

928
2
1856

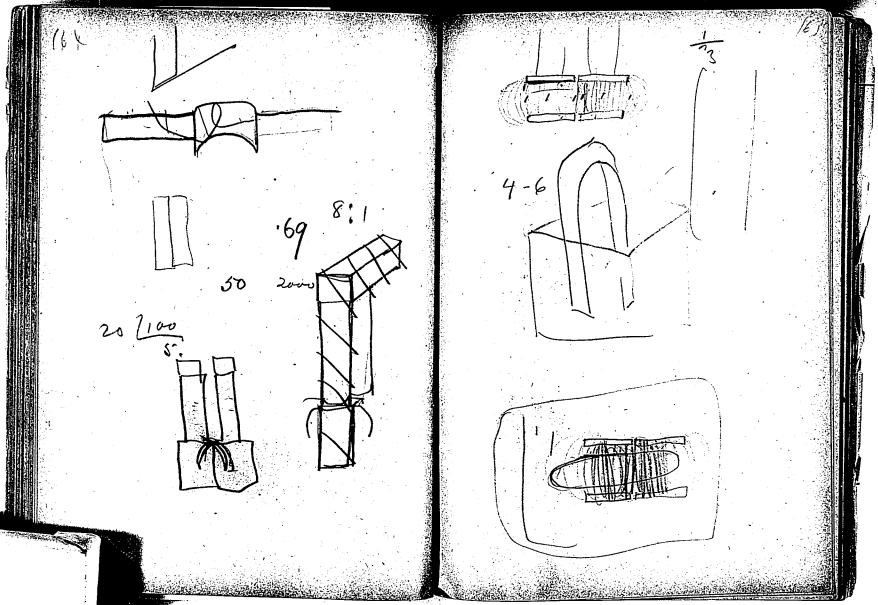
825
799

2 lbs 1.4 oz at 4 feet

810
12
1620
810
9720
2

3 × 4

About 19,440. ft. lbs.


16
.69
8:1
50
20
100
4-6

Meter Shunt No. 4

June 22 1880

20 cells 108 = D

~~around~~ 8,8 Ohms

100 = D

~~75~~ Galva. current same
magnet way
up shunt open.

78 R
79 L

on Shunt No 4

On 4.01 Ohms with cell

57 L
55 R

On cell deposition

25 L
24 R

168

167

On Shunt No. 4

80 R

80 L

Made 19 on Shunt No. 4

126 L

133 R

126 L

On 4.01 Ohm

96 L

101 R

~~On Shunt~~

165 L

180 R

On 4.01 Ohms

131 L

142 R

170.

16	4.
8.	
128	2.1072
257	2.4099
	4.5171

32,900

1.6532
.7404
2.3936

247 candles per H.P.

Small Bent fibre 171

102 Volts

Two lamps in series

	6296
	6296
	2000
	800
	15880
	76.9

102	2.0086
102	2.0086
	1.6464
77	8.1135
	3.7771
5980	4.5185
	.7414

5,5 per H.P.

45 candle	3.7771
	1.6532
	2.1239

133 ft lbs per candle

172

Small bent fibre lamps

4144 ft lbs

83.9 Ohms

88.6 Volts.

22 candles from two lamps in series

88000 / 120 = 2.1293 — 45185 / 2.0792 = 15 candles per H.P

273 ft. lbs. for candle

4144 / 22 = 188 ft. lbs per candle

3.6174 + 1.3424 = 4.5185

4.5185 − 3.6174 = .901

7.9 per H.P

Small test fixture Carbide
2½ hours at 58.5 standard
candles from two one minute
brighter than the other.

104 ft. lbs. for candle

65.5 1.8162
14.5 1.1642
6520
2
1.3040

20.
2
40

66.5 1.8228
13.5 1.1303
.6925
2
1.3850

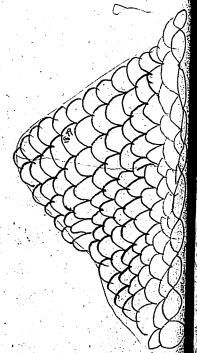
24.3
2
48.6 candles
16.2
64.8 candles
48.6 1/3 More than
9.7 standard candles
58.5

176

Jablochkoff

400) 33000

82.5 ft. lbs. per candle



177

102	2.0086
102	2.0086
	1.4464
75.4	81.1226
6110	3.7862
58.5	1.7672
	2.0196

.104 ft. lbs. per candle

15080

7540

.5185

560

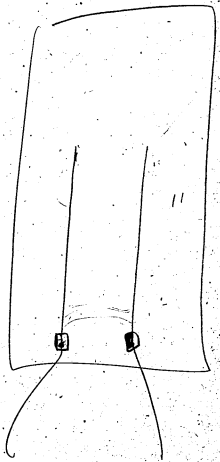
4 . 5185
3 . 7862
.7323

3.4 per H.P.

.7323
1.7672
2.4995

316 candles for H.P.

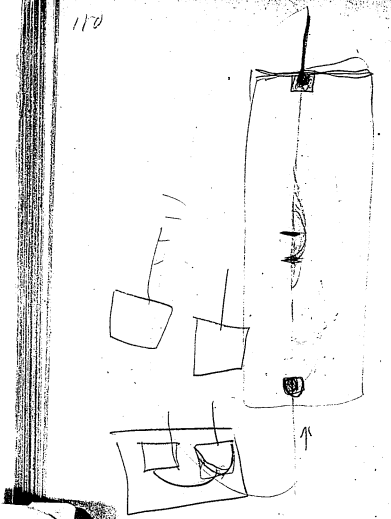
5 hours 10 minutes
7 hours 10 minutes



2 cells
94 L
93 R
192 R
195 L

6½ candles

6280
1000
650



Small Bait Fibre

9 candles

9.4
93
18.7

9.35	.9708
1.08	.0334
8.66	.9374

9 candles

			Ohms
207	L		500
205	R		100
412		2.6149	62.50
		.9374	7780
47.6 Volts		1.6775	3890
		1.6775	
		1.6464	
Ohms 38.9		8.4101	
		3.4115	

2580 ft lbs
285 ft lbs. per candle

112

8 candles

203 R

5-5-0

4052.6075 38.4 Ohms
.9374
1.6701
1.6701
1.6464
38.4 8.4157
3.4023

~~1500~~
2520

113

June 23 1880

Test small wrought iron motor 80 Volt on armature 12 Ohms in line with magnet

2 lbs 14 oz weight at 5 feet circumference

1060 revs per min

5650 · Speed of Prony Shaft

2

1130 r.p.m.

15

5650

1130

16950 ft lbs

156 The Rowing gave a great deal of trouble

30 443
20 3987 ft.
900

at 4 feet

613
2
1226 r.p.m.

at ~~6 feet~~
509
2
1018

~~at 8 feet~~

1018
18
8144
1018
Abt 8,324 ft. lbs.

Small test fibre
half length

Tungsten vil lamps 8 ~~Shunt~~
2-3 22 cp candle standard Candles
Started
3 170
56.6 Volts

6290
1000
200 | 7290
36.45 Ohms

22 candles standard
170
2-24 stopped for ~~next~~ Tantor
2-57 6290 Started
800
7090

Test of 2-24

9 | 7018 — 30 20 — 900

257
224
33

57
40
97 | 9
33
64 minute

50 50 25 25 | 216 | 8 | 20.6 | 4

56.6 1.7528
56.6 1.7528
1.1464
8.4389
3900. 3.5909
4.5180
8.46 for H.P. .9276
3.5909
1.3624
2.2585
180 ft lbs per candle

4-35 Reversal poles
stopped about one minute
started at 5.50

5.50
2 3
347
34
3h13m

Gave light for 3 hours
and thirteen minutes
22 candles

3 hours 13 minutes

192

4

2

1155

13225

403

105

5 105

5600

6250

2117

1178

170

5522/6 = 920 r 2

920 r 2

311

193

No 1177

Put on at 6.35 a.m. started C. 40 ohms while hot

Def 196. basted at 6.50

Camp No 1179

Def 205 45 ohms hot

22 C put mat 6.55.

basted at 7.3

Camp No 1159

Def 345 C.P. ~~450~~ 37.4 Candles

105 ohms hot put on at 7.10

5322 ft lbs basted at 9.5

4/5522

138.

7.10

1.55 m

5522 3.7419
37.5 1.5740
2.1679

147 ft. lbs per candle

3 | 196
65.3

1.8149
1.8149
1.6464
compass 8.3979

4720 3.6741
1.3424
2.3317

215 ft lbs per candle

at 58 candles both lamps
104 ft. lbs. per candle
at 22 candles one lamp in globe
180 ft. lbs. per candle
at 22 candles small lamp in Tube
215 ft. lbs per candle

65 1.8129
15 1.1761
.6368
2
1.2736

18.7
2
37.4 candles

Large fibre No 1168

Kerosene oil lamp
= 8 candles

9-52 Made large d2 X.9 12
4" long bark fibre
No. 1168
44 candles

348 H.R 3 ± 1 Volt
116 Volts
6290
6290 1258.0
3800
16380
81.9 Ohms 16

10-8 345
115

200

348 : 355 :: 81.9 : X

2.5502
1.9133
7.4584 4.4635
1.9219

83.5
81.9
1.6 Two 3 Ohm boys in multiple arc

19
7
9
35 minutes

Large test fibre 201
No 1168

116
118 2.0645
2.0645
1.6464
81.9 8.0867
3.8621
7280 ft lbs.

3.8621
3.6435
.2186

165 ft. lbs. per candle

10-11 Stopped to change
10-57 Started
11-44 Stopped
11-55 Started

11-44
35 minutes

Large bent fibre
0".012 X 0".012 No. 1167

Kerosene oil lamp
8 candles +
Screen at 11 candle mark

10-15 Lamp 40 candles
curled mark Mahogany
44 candles
352 = Ω on H R
1173
82.4 Ohms

2.0688
2.0688
1.6469
8.084.140 | 7380
3.8681 | 1844

5
7
10

22 minutes to 11-27
35
57 minutes

12 580
4450
17030
851

57
15
72

118 2.0719
2.0719
851 1.6464
8.0797
3.8609
7206 44 1.6435
1.2174

164 ft. Wis. per candle

Batt No. 1167

10-20 Stopped to change
10-57 Started 48 candles
11-4 Stopped Resume to Lunch
11-15 Started
350 I+R
48 candles
11-25 Stopped
11-27 started 44 candles
12-2 Stopped
355 = D 3 = 1 Volt
118 Volts
After 10 P.M
15 minutes Jehl
72 minutes

342 : 355 :: 79.8 : X

1.9020
2.5502
9.4660
1.9382

86.7
79.8
6.9 2 boxes in series

Boat barge No. 1158

Slightly irregular

Bright 20 million H.R. 6 ft 6 ft

10-30 Started

342 H.R.
114
12580
3380
1596 0
79.8 / 114

2.0569
2.0569
1.6464
8.0980
3.8582
1.6435
2.21 ft

7220

16 # ft. lbs. per cu. ft.

208

209

Bank No 11548

10-34 Stopped to change

1057 Started

50 Banked

H Stopped

Candle power before this 48-50 as the kerosene lamp had increased its pressure by heating

11 minutes

Results

	Lt lbs per candle
Two small lamps one very high	10 4
105 Ohm Lamp & Watt giving 37.5 candles	147 Jehl
Large bast fibre at 44 candles	164
Small bast fibre in globe at 22 candles	180
Small bast fibre in tube at 22 candles	215
Small bast fibre in globe 9 candles	285

213

Lamps - June 24

Small test 22 candles

- more than 22 candles

Large fibre 1158

1168

1167

Large fibre Flamingo

Time burned 24

3 hours 13 minutes

2 hrs 30 ——

9 ——

35

1. hour 12 ——

22 ——

24

13.6 — 1.1335
13.6 — 1.1335
1.2469
Comp 69.9 — 8.1551
2.0685

11.7 ft. lbs.

43.3 — 1.6365
1.6365
1.6464
52.95 — 8.2761
3.1955
15.70 — .6021
3.5934

392 ft. lbs. per candle

48.3 — 1.6839
1.6836
1.6964
51.45 — 8.2886
3.3028
6.5 — .8129
2.4899

309 ft. lbs. per candle

June 24-25-26

Bast fibre 0.012 V 0.012 — 0.024 R 27.3

New candles

20 cell 65 L
65 R
21.6

Temp 85° F

Red
6290
7700
13990
69.95

2220

3 | 41 = N — 3 = 1 Volt
13.6

6290
4500
10790 ohms — 4 candles
5 3.95
130 = D
433

6 1/2 candles

145 = N = 4.83 Volts
6299 = 51.45 ohms
4000
10.290

1.7269
1.7269
50.4 ct 1.6464
8.2971
3.3973
12 1.0792
2.3181

208 ft. lbs. per candle

5.03 1.7016 afternoon
1.7016
1.6464
8.2971
2220 3.3467
.1903
2.4436

277

Evening page 279

259 ft. lbs

Small bast fibre

12 candles

1160 = Ω
5-3.3 Volts
6290
3800 Ohms
10090
5-0.45

8 candles
1511 = Ω
5-0.3
6290
3800 Ohms
10090
5-0.45

1.7016
1.7016
1.6464
8.3037
3.3533
1.0792
2.2741

225.0
12

188 ft lbs per candle

56.6 1.7528
1.7528
1.6464
47.7 8.3215
3.4735
19.2 1.2833
2.1902

155 ft. lbs per candle

160 = D
50.3

12 candles
6290
3650 Ohms
19940
49.7

170 = D
56.6

19 1/2 candles
19 candles
6290
3250 Ohms
19540
47.7

1.7619
1.7619
1.6464
46.7 8.3307
3.5007
1.3424
2.1575 143 ft. Ms

1.7582
1.7582
1.6464
8.3497
3.5125
1.3522
2.1603 144 ft. Ms

Small boat Inne 24

2-35 22 candles

173.5 = D
57.8
6290
2050 Ohms
9340
46.7

~~22~~ 5 candles

3-5 2650 Ohms in box
172 ÷ D L
173 = D R 57.3

2650
6290
8940
44.7

Candles

1143
1143
2286

New foreigner

3-6 Lighted
24 candles
22.5 candles

3-13 Stopped

224

1.7101
1.7101
1.6464
64.95 8.1875
2260 3.3541
1.5 0.1761
3.1780

1500 ft. lbs per candle

53.6 1.7528
1.7528
1.6464
62.45 8.2045
3.3565
2270 0.4771
2.8794

757 ft. lbs. per candle

227

Small boat fibre in tube No. 1182

3-17

$\frac{115.4}{51.3} = D$

6290
6700
12990 6495

1 1/2 Candle

3 candles

$\frac{170}{56.6} = D$

6290
62.00 Ohm
12480
6245

1.7993
1.7993
1.6464
8.2299

3.4749 2980

7.5 .8751

2.5998

399 ft. lbs to one candle

69.6 1.8426
1.8426
1.6464
54.9 8.2604

3.5920
13 1.1139

2.4781

301 ft. lbs

2-25 189 189 63 Volts.

7½ candles

6290
5500
790
58.9

200 198 199 198

13 candles

6290
4700
1590
54.9

1.8488
1.8488
1.6464
8.2848
3.6288
1.3010
2.9278

212 candles per candle

Same 24.8025

Std candle from 1182 tube

212 = 0

212 - 70.6

20 candles

6290
4100
10390
51.9

2 30

1,8751
1,8751
1,6464
87.9 8.0560
13.4526
4771
2.9755

945 ft. lbs. per candle

1.9410
1.9410
1,6464
84.6 8.0726
3.6010
.9031
2.6979

499 ft. lbs. per candle

Lamp 1187 23
Large test combined with Humidity

6290
6290
5000
17580
87.9
3 candles

225 = N
75 Volts

8 candles

1262 = N
87.3 Ohms

4350
6290
6290
16930
84.65 Ohms

2.0025
2.0025
1.6464
78.1 8.1073
22 8.6576
2.4163

26.2 ft. lbs. per candle

115 2.0607
2.0607
7.6464
69.4 8.1580
3.9264
8440 1.6435
2 2829

192 ft. lbs. per candle

Lamp 1187

302 = D
100.6

22 candles

6290
6290
3050
15630
78.15

3-40 44 candles 66 inches

~~3=40~~
345 = D
115

6290
6290
1300
13590
6940

2092
1626
1466
233
116 grains

Lamp 1187

3-51 blew out candles

blue at lamp

4 stopped for George

1049
1043.5 3/4 hour
20921.5

2286.
193.5 4/6 = 1 candle
4
6|774.0
129. grains an hour

4-5 started

4-7 22 minutes

6-6 stopped

1.8235
1.8235
1.6464
99.1 8039
52973

1960 ft. lbs. per candle

Regular test No. 1181

4-7 Candles lighted

1 Candles

200 = N
66.6

6258
6290
6290
1080
19830
99.15

1.9345
1.9345
1.6464
8.0297
9.3010
2.8461

702 ft. lbs per candle

2.0253
2.0253
1.6464
8.0635
16 8.7959
2.5564

360 ft. lbs per candle

M 1181

~~28~~
86.
5 candles

6100
6290
6298
18680
93.4

16 candles

6290
6290
4700
17280
86.4
1302 ≈ D
100.6

240

2.0645
2.0645
1.6464
8.1158
8.3565
2.2477

176 ft. lbs per candle

No. 1181 June 24

44 candles

352

10 minutes Very high one

275 ft lbs

350 R
360 L
116

2750
6290
6290
15330
7666

2.0492
2.0492
1.6464
8.1085
8.3565
2.2098

162 ft. lbs per candle

1185

335
112
2900 Ohms
44 candles
5 minutes
Slipped out of clamp

2900
6290
6290
15580
779

2,0471
2.0471
1.6464
8.1018
8.3565
2.1989

158 ft. lbs per candle

large boat
W 1153 with partition

337
1116
3250 Ohm
6290
6290
15830
7915

44 candles

5 minutes

1.9850
1.9850
1.6464
8.0752
8.7959
2.4875

307 ft. lbs. per candle

1153 with Lantern

16 candles

2908
96.6

4250
6290
6290
16830
84.15

2.0386
2.0386
1.6464
8.9742
8.7959
2.4937

311 ft. lbs per candle

No 1191 Good lamps

328 = 10 on H.R
109.3
16 candles

8650
6290
6290
21230
106.15 Ohms

2.0194
2.0194
1.6464
8.0026
8.7959
24837

304 ft. lbs per candle

Lamp No. 1183

16 candles
very good at dull red

321 N.R

21230

16 candles

314
104.6

8290
6290
7360
19880
9940

206

afternoon

2.0472
2.0473
1.6464
8.8976
8.7959
2.4345

271 ft. lbs per candle

Evening

2.0607
2.0607
1.6464
8.8962
8.7959
2.4599

288 ft. lbs per candle

207

Lamp No 1190

16 candles

(335 = D
1 11.6

afternoon
345
115

6250
6290
6290
6500
25370
126.85 Ohms

6250
6290
6290
6650
25480
127.4

Evening

345

260

1186

261

Good custom

16 candles

292

947.3

62 50
6290
6290
100

19930

$99.65

1189

16 candles

319 N.R
106.3

950
6250
6290
1290
19580
97.9

Afternoon

1.9699
1.9699
1.6464
8.0724
8.7959
2.4535

284 ft lbs per candle

Evening

1.9805
1.9805
1.6464
8.0788
8.7959
2.4841

305 ft lbs per candle

No 1166

16 candles

280 = D
93.3

287 = D
95.6

4350
6290
6290
16930
84.65

4100
6290
6290
16680
83.40

afternoon

2.0294
2.0294
1.6464
8.0070
8.7959
2.5081

322 ft. lbs per candle

Evening

2.0414
2.0414
1.6464
8.0127
8.7959
2.5377

345 ft. lbs per candle

New Batteries next day

1.9474
1.9474
1.6464
8.0320
8.7959 3.5736 234 ft. lbs per candle
2.3691

DVC

No 1180

16 candles

321	330
107	110
1050	600
6290	6290
6290	6290
6250	6250
19680	2 19430
98.40	97.15

1265
84.6

6290
6290
6000
18590
929 Ohms
Ohms

No. 1180

3.5736

3740 ft. lbs.

4.5155
3.5736
.9447

8.8 per H.P.

16
1.4
64
15
224

2½ lbs 6 (13.4 / 2.2)

11.2 cts

From Book 48 End

Coal taken at $3 per ton

July 29 2240 lbs

3 X 5 = 15 — $2.50 — 3.0969 — 1.1761 — 4.2730

18700 / 2240 = 8.36 tons — 3.3502 — .9228 — .4771 — 3 — 1.3999

$24 — 187.5 — 2.2729 — 9.1270

3 lbs 13.4 cts per M for coal

Stoking $4.00 per day

4 — 2.6021 — 2.2729 — 3292

2.1 ct for stoking

Water for boilers

Estimated at 1/3 coal ~~labor~~

Summer 4 cts per M

Rent $5.000 per year

5.000 5.6990

4.8293

.8697

7.4 cts per M

9

Summary 6 per H. P.

Depreciation	7.3
Taxes	3.7
Labor	6.9
Coal	13.4
Stoking	2.1
Water	4.
Insurance, Rent &	7.4
	44.8

44.8 cts at station

3 lbs per hour

2½ lbs per hour 42.6 cts

at consumers 46.9 cts

Mains 44.7

1.6767
1.6767
1.6464
8.3170
9.0969
2.4137

25-9 ft. lbs

Ex

Small boat

8 candles

143 = D
47.6

3350
6290
9640
48.20

$6\frac{7.5}{7} : 100 :: 16 :$

$7\frac{1}{1600}$

23.

Executive 2 cts per M

4 cts per M

Say 50 cts per M cost at consumer

Old Paper

Dividends at 1.00 per M

125 000 invested

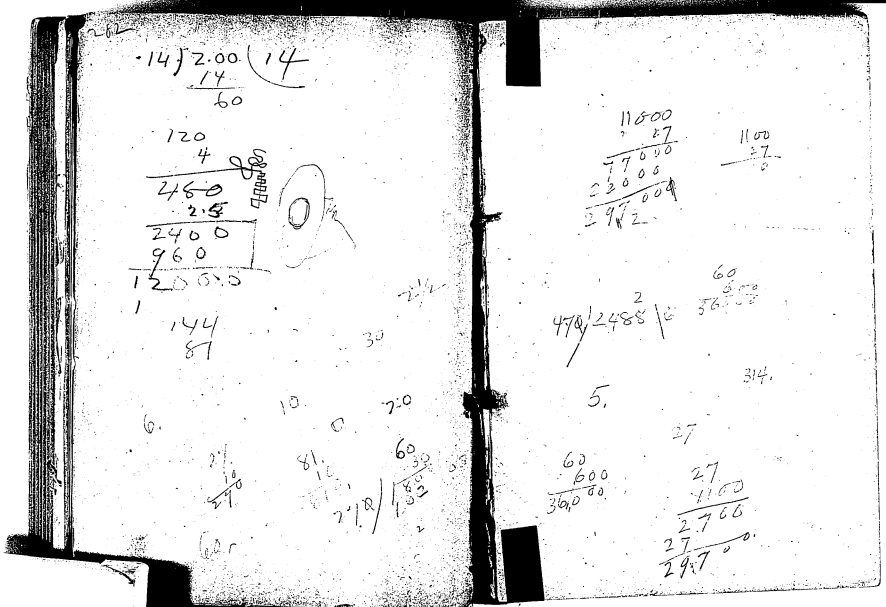
675 00 M annually made

$33.750 profit

About 33⅓ dividends

$1.50 per M

66⅔ dividends



Menlo Park Notebook #40 [N-79-03-31]

This notebook covers the period March 1879-May 1880. The entries are by John W. Lawson and include notes on metal alloys made and tested and notes on experiments with pyrites. The label on the front cover is marked "Alloys and Ores." The book contains 288 numbered pages.

Blank pages not filmed: 28-47, 70-73, 78-99, 112-139, 142-163, 166-175, 178-179, 182-275.

No 46

LIBRARY OF THE

BOARD OF PATENT CONTROL,

129 BROADWAY, NEW YORK.

from Library
of the U.S. Pat. Off.
Sept 1, 1896.

No 40

Alloys
March 31/99.
J. W. Lawson

Copper & Zinc

No 1. 90 % Cu, 10 % Zn
Melted Cu in crucible, added
Zn in small pieces; stirred
and reheated, then poured
into moulds –

No 2. 80 % Cu, 20 % Zn
Treated same as preceding

No 3 70 % Cu, 30 % Zn
Melted Cu in crucible, then added
Zn; stirred, and reheated
longer time than the pre-
ceding –

[ITEM FOUND IN BOOK]

Heat ~~or roast~~ roast
Alumina with $Pt(CO_3)$
or $Pt(C_2H_3O_2)_2$
Use platinum alumina
or

Copper		Zinc		
"	90	"	10	1
"	80	"	20	2
"	70	"	30	3
"	60	"	40	4
"	50	"	50	5
"	40	"	60	6
"	30	"	70	7
"	20	"	80	8
"	10	"	90	9

Varying as above

~~Copper & Mc Gord~~

" & Lead

" With to be Cadmium

" " Antimony

" " Arsenic

Zinc & Iron

" " Lead

~~" " Cadmium~~

~~" " Antimony~~

" " Arsenic

Iron & Lead Mc Gord

" With to be Cadmium

" " Antimony

" " Arsenic

~~Lead & Cadmium~~

~~" " Antimony~~

" " Arsenic

Cadmium & Antimony

" With to be " Arsenic

Antimony & Arsenic

No 1 60 % Cu, 40 % Zn

Melted Cu in crucible, then added Zn in small pieces, stirred well, and poured into mould without reheating in fine.

No. 5 50 % Cu, 50 % Zn

Melted Cu in crucible, ect:, then reheated; a great loss of Zn by volatilization

No 5.2 50 % Cu, 50 % Zn

Melted Cu in crucible, added Zn, stirred well and poured in mould without reheating

No 6 Cast over again (Exceeding by brittle)

Melted Cu in crucible, added Zn, covered with powdered ch, nichrome and carbon

Carbon screened to prevent volatilization of Zn

No. 9 Reheated

Zn added same as formerly

No. 5½ 45.11% Cu 54.11% Zn
% on Cu was left wrong

Melted Cu in crucible, ect.; poured into mould without reheating -

No. 6 40% Cu, 60% Zn
Treated same as preceding

No. 7 30% Cu, 70% Zn
Melted Cu in crucible, added Zn in small pieces, and reheated - Loss of Zn by volatilization - Result, page 6

No. 8 20% Cu, 80% Zn
Treated same as preceding (Loss of Zn).

No. 9 (Alloy of Zn & Cu)
10% Cu, 90% Zn
Treated same as preceding -
Results, page 6

Copper & Iron

"As a rule iron may be alloyed with most metals; but its alloys, always difficult to effect, and in the majority of cases only with a small proportion of iron, have up to the present time resulted in very few applications to the arts."
Fesquet, page 98.

No. 1
90 % Cu, 10 % Fe

Melted Cu and Fe in separate crucibles, then added one to the other, mixed, and poured into mould.

No 2.
80 % Cu, 20 % Fe

Melted Fe in crucible, then added Cu in pieces & heated and poured into mould.

The mass not homogeneous. The Fe distributed in spots throughout the bar - with large 10

No. 3.
70 % Cu, 30 % Fe
Treated same as preceding
Stirred well, [illegible]

No. 2." Brought
Melted Fe and Cu in separate crucibles, then
Fe into Cu - not just proportion of Fe; as poured
crucibles with Cu, but remained
crucible after pouring alloy out.

Impossible to mix
in proportions
in separate

Two Tins, Iron
bar

No. 5 20% Cu, 70% Fe

Exposed iron in crucible to heat of fire for two hours; part melted, surface of molten iron covered with a carbonaceous looking substance added copper in small pieces and reheated; a pasty mass, would not melt. Time iron was in fire from first, 3½ hours.

Melted Fe in crucible, then added Cu while crucible was in fire. Let crucible remain in fire sufficient time for the Fe & Cu to become thoroughly mixed, then just before pouring stirred well.

Treated the following all alike:

No. 1 90% Cu, 10% Fe
" 2 80% Cu, 20% Fe
" 4 60% Cu, 40% Fe
" 5 50% Cu, 50% Fe

" 7 30% Cu, 70% Fe
" 8 20% Cu, 80% Fe
" 9 10% Cu, 90% Fe

The alloys not homogeneous, separation of Fe and Cu, the Fe distributed in patches throughout the bar.

Copper and Lead

—"the alloys of copper and lead are difficult to obtain by the direct process in one fusion."

Fragnet, 87

"Appears to be a mixture of two alloys, one containing more copper and fusing at a higher temperature, the other more lead and fusing at a lower temperature. The latter flows out when the metal is gently heated."

Gmelin V, 484

Melted Cu in crucible, and added Pb in small pieces; stirred well and poured into mould.

Treated the following all alike:

No. 1 90 % Cu, 10 % Pb
After polishing, appears to be homogeneous

No. 2 80 % Cu, 20 % Pb
Looks as though copper had "settled" to the surface.
After polishing, cloudy

No 2a 66⅔% Cu 33½% Pb
Homogeneous

No. 3 70 % Cu, 30 % Pb

No. 4 60 % Cu 40 % Pb.
Surface crystalline.
After polishing, smoother

No. 5 50 % Cu, 50 % Pb
Surface crystalline
After polishing, cloudy, showing spots

No. 6 40 % Cu, 60 % Pb.
Showing separation of Pb

No. 7 30 % Cu, 70 % Pb
Addition of Pb + molten Cu solidifies Cu, placed in tin and [illegible]

formed — In the bar, plumbiferous copper; in the casting bar, argentiferous lead —

No. 8. 20% Cu, 80% Pb

Introduced Pb into molten Cu while in fire, let crucible remain a few minutes, then poured into mould —

No. 9 10% Cu, 90% Pb

Treated same as preceding

No 8² 20% Cu, 80% Pb

After mixing the two and allowing to cool, remelted — Perhaps not full proportion of Pb — Part may have volatilized —

Lead and Antimony

Melted Pb, then added Sb, agitated, skimmed thoroughly, and poured.

Tried the following mixtures

No. 1, 90% Pb, 10% Sb
" 2, 80% Pb, 20% Sb
" 3, 70% Pb, 30% Sb
" 4, 60% Pb, 40% Sb
" 5, 50% Pb, 50% Sb
" 6, 40% Pb, 60% Sb
" 7, 30% Pb, 70% Sb
" 8, 20% Pb, 80% Sb
" 9, 10% Pb, 90% Sb

Melted Pb, then added Cd; agitated, stirred, and poured. Treated the following alike.

No. 1 90 % Pb, 10 % Cd
" 2 80 % Pb, 20 % Cd
" 3 70 % Pb, 30 % Cd
" 4 60 % Pb, 40 % Cd
" 5 50 % Pb, 50 % Cd
" 6 40 % Pb, 60 % Cd
" 7 30 % Pb, 70 % Cd

Melted Cu in crucible, then added Sb in small pieces, and fused without reheating.

Treated Nos. 1, 2 & 3 alike

No. 1 90% Cu, 10% Sb
" 2. 80% Cu, 20% Sb
" 3 70% Cu, 30% Sb

Melted Cu in crucible, and introduced Sb while crucible was in fire; left it remain in fire until thoroughly mixed.

Treated the following alike:

No. 4 60% Cu, 40% Sb
" 5 50% Cu, 50% Sb
" 6 40% Cu, 60% Sb
" 7 30% Cu, 70% Sb
" 8 20% Cu, 80% Sb
" 9 10% Cu, 90% Sb

Watts, 1, 703
Mentions not more alloys of Cd:-
[illegible] Cu, 84.2 Cd
79.3 % Hg, 21.1 % Cd
70 Pt, 30 Cd
Fregnet, 15-2 Au, Ag, Cu, Hg & Cd, an amalgam

Zinc and Cadmium

Very few alloys of Cd are known. Watts, 1, 703; Fregnet, 15-2

Melted the Zn in crucible, then added Cd in small pieces; reheated and cast. Treated all of this series alike.

No. 1, 80 % Zn, 14 % Cd
No. 2, 30 % Zn, 21 % Cd
" 3, 70 % Zn, 30 % Cd
" 4, 60 % Zn, 40 % Cd
" 5, 50 % Zn, 50 % Cd
" 6, 40 % Zn, 60 % Cd
" 7, 30 % Zn, 70 % Cd
" 8, 20 % Zn, 80 % Cd
" 9, 10 % Zn, 90 % Cd

Efflorescing and very diffusingly in effecting Thin Sections

Zinc and Antimony

"The alloys of antimony and zinc are but little known — They have presented but little interest to experimenters"

Ferguson, 109

Melted Zn, then added Sb, and reheated — Treated the following alike =

No. 1, 90 % Zn, 10 % Sb
" 2, 80 % Zn, 20 % Sb
" 3, 70 % Zn, 30 % Sb
" 4, 60 % Zn, 40 % Sb
" 5, 50 % Zn, 50 % Sb
" 6, 40 % Zn, 60 % Sb
" 7, 30 % Zn, 70 % Sb
" 8, 20 % Zn, 80 % Sb
" 9, 10 % Zn, 90 % Sb

These alloys oxidize by heating very readily

By heating the CdS in graphite crucible decomposition took place at white heat. Vapours of S, and a metallic crystalline sublimate in upper part of crucible, crystallising in octahedra.

Mixtures of the Sulphides

PbS & CdS

PbS volatilizes at temperature lower than that necessary to fuse CdS. When heated in contact with the air it is decomposed

Mixed the two, heated in crucible and exposed to white heat — complete volatilization; exposed to strong red heat, obtained a button. The temperature was not raised to that degree sufficient to fuse CdS, free from other substances, so that it may be unequally distributed throughout PbS, held in suspension while the PbS was in a molten state.

Note book 8-2

No. 1
18 grams PbS, 2 grams CdS

" 2.
16 " PbS, 4 " CdS

" 3
14 " PbS, 6 " CdS

" 4
12 " PbS, 8 " CdS

No. 1 2 grams CdS
18 " PbS

" 2 4 grams CdS
16 " PbS

Heated in lutted Hessian crucible to strong red heat —

No. 4

24 grams Cu_2S
15 " Fe_2S_3 } + S

Cu_2S and Fe_2S_3 Pulverized and mixed, placed in graphite crucible and exposed to white heat. Then added 8 or 10 grams sulphur, and poured as quickly as possible. A ragged solid remained in bottom of crucible; examined it, appeared to be of same composition as that poured, fracture the same. Placed in crucible and treated same as before. Same result. Part remained in bottom of crucible. Placed the second pouring into crucible and treated as before —

A yellow brittle bottom

No. 5

27 grains Cu_2S
15 " Fe_2S
2 " Pb_2S

Result: The button yellow, part pearly yellow.

No. 6

23 grains Cu
21 " Fe_2
36 " S

Mixed the Cu and Fe_2, then placed in alternate layers in the crucible. The sulphur and mixed metals. Luted cover on crucible, and placed in white heat.

A large portion of this iron did not unite with the Cu_2S formed but remained in crucible in the form of Fe_2S

16, 7.
28 grams Cu
7 " F_2
2.1 " S

Dried, and fused at a white heat; one side of the button covered with metallic copper.

16,8
23 grams Cu
2.1 " F_2
1.6 " S

Treated same as preceding. 8 Globules scattered through the button; light yellow color, magnetic — Magnetic Sulphide.

16,9
5.4 grams F_2
1.98 " IA_2

Heated in covered crucible; obtained a button and

@ a flask powder

No. 11 E
54 grams Copper
108 " Arsenic.
Fused Together in Lutted crucible
Dirty grey crystalline button

No. 12
22 grams Ferrous Sulphide
15 " Metallic Copper
Fused together in covered crucible
Dirty Yellow button.

No. 13
Copper Arsenide
Iron " expended parts
Fused together in crucible
No nuts nuts well

No. 14 Copper Arsenide
Sulphide expended parts
Fused together in crucible
No nuts nuts well

J. Lawson

No. 15

75 grams Lead
30 " As

Melted Pb in crucible, then added As, slight loss by volatilization

No. 16

38 grams Antimony
62 " Arsenic

Partially melted Sb, then introduced As — Great loss by volatilization.

No. 17

70 grams Bismuth
5 " Arsenic

Melted Bi, then added As

No. 18

34 grams Cadmium
24 " Arsenic

Melted Cd, then added As
Used bottle, button, silver, butter

No. 20

28 grams Feldspar
20 " Cu_2S

Fused together in hessian crucible.

No. 21

Same proportions as No. 12
$Fe_2S + Cu$

Exposed a longer Time to heat

No. 22

Same as preceding.
Exposed to still stronger heat

No. 23

24 grams Fe_2
18 " S

Exposed together to white heat nearly two hours.
Almost infusible in furnace.

66

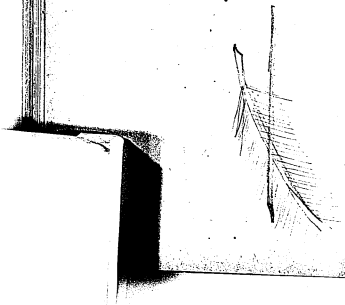
Oct 24

19 grams Cuprous Sulphide
2/6 " Iron Sulphide (Magnetic)

Mixed together in a crucible

Ingot Alloy of Cu & Zn [illegible]
added a small quantity of
nickel Phosphide -

This is a
Pot



$Cu\,SO_4$

$Cu\,SO_4 + 5H_2O$

$63.532 + 32.064 + 64 + 5(18)$

$95.596 + 90$

185.596

249.5

$5)\overline{249.5}$

$(NH_4)_2SO_4$

$14 \quad 32$

$8 \quad 4$

$2 \quad 64$

$32 \quad 96$

96

128

64

$20)\overline{28}$

$3)\overline{6\ 8}$

2 Dr.

100

Mar. 14 –

No. 1 Quite strong ordor of H_2S

Nos. 2 & 3 action going on Solution Colored blue (Quite deep) No H_2S given off – [That is no ordor]

No. 4 Energetic action & short time after being placed in solution H_2S evolved –

No. 5 – action not quite so energetic as No. 4.

Mch. 10 '80 – A.W. Lawson (C)

Some small pieces chalcopyrite from Eq Copper mines Va were placed in bottle and dilute ~~sol~~ H_2SO_4 – 5% H_2SO_4

2. Mch. 5, H_2SO_4 [Sp. gr. of acid 1.2 3] Placed in warm place. Equal quantity of the Chalcopyrites in sulphuric acid placed in warm place –

3. Same as preceding placed in ordinary temperature –

4. Chalcopyrite & copper shavings in sulphuric acid placed in warm place –

5. Same as preceding but lead shavings instead of copper

6. Chalcopyrite, caustic soda, & H placed in warm place. Caustic soda solution quite strong –

Mar. 22

7- Bichromate potash, sulphuric acid, coke and chalcopyrites placed in warm place

8- Chloride ammonium and coke - placed in warm place - [5% H_2SO_4]

9 Manganese dioxide, coke, ~~ammonium chloride and~~ chalcopyrites equal quantities and a small amount of ammon. chloride -

Mar. 25

10- Carbon, carbonate potash and chalcopyrites -

11 ditto with carb. ammon -

12 ditto cyanide potassium

13- Same as No. 2. ~~Use~~ ~~using tellurium tools~~ to see if the same reaction occurs as in No. 2 —

Fused chalcopyrite with metallic lead, part of the lead entered into combination with the other two and sulfides forming an easily fusible sulphide; a bar of this was cast and used as an anode to try whether the copper could be removed from it by means of the electric current —

14 Same as No. 2 - acid more dilute 5-7% HNO3

Experiments with electric pyrites — April 13/80

A glass jar was taken, in this was placed a porous cup; in the porous cup was placed two pyrites together with a small quantity of common salt; in the glass vessel and around the porous cup was packed common salt; two carbon plates were taken one placed in the porous cup in contact with the pyrites the other in the glass vessel in contact with the salt; wires leading from both plates were connected together at the ends; water was then added to both vessels

Powdered marble, coke and pyrites mixed together and placed in water.

8 Sodium carbonate, coke and pyrites in water.

4 Calcium flouride, coke and pyrites in water.

5 Manganese dioxide, sodium chloride, coke and pyrites in water.

6 Pot: cyanide, coke and pyrites in water.

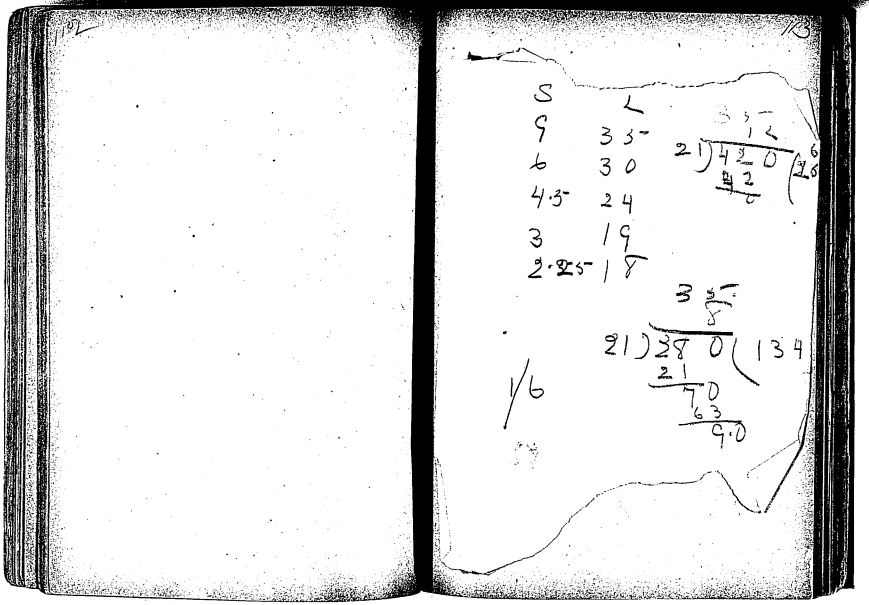
7 Caustic lime, coke and pyrites in water.

8 Bleaching powder and pyrites in water.

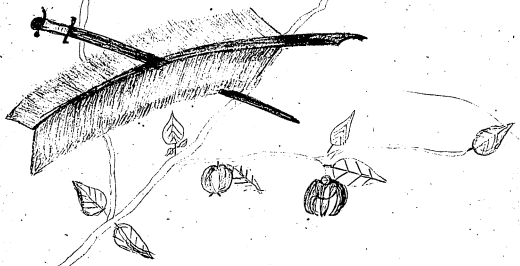
Surface attraction of the pyrites

May 11 1880

The bottom of a shallow vessel was covered with Hg. (impure) some powdered charcoal finely was thrown on the surface of the Hg. a sheet of blotting paper placed over this and on the blotting paper was placed a clean sheet of carbon; very dilute sulphuric acid was then poured into the vessel until the carbon plate was covered with it; the carbon was then connected with a platinum wire dipping into the Hg and the vessel set aside for a few days -



The pen is mightier than the sword.



$Fe_2S_3 + 4HCl = 2FeCl_2 + 2S + S$

$\left.\begin{matrix} FeS \\ Fe \end{matrix}\right\} S +$

450
80
45.00

45.0
3
135.0

2200

200 grains

244

24
24
576

48
576

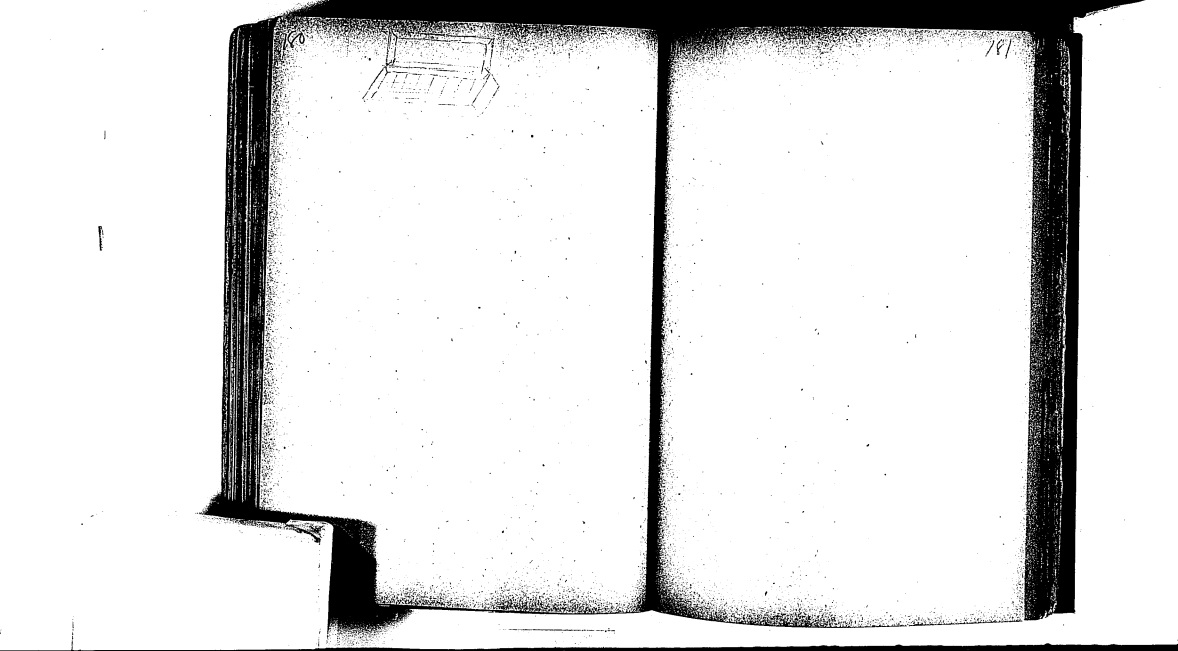
5.

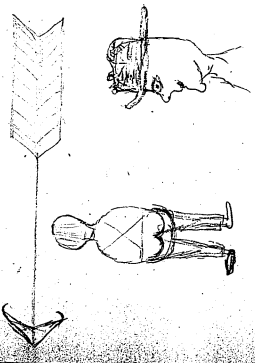
2000
5
450 | 10000 (244
1000
1000.0
900.0
2000.
1800
200

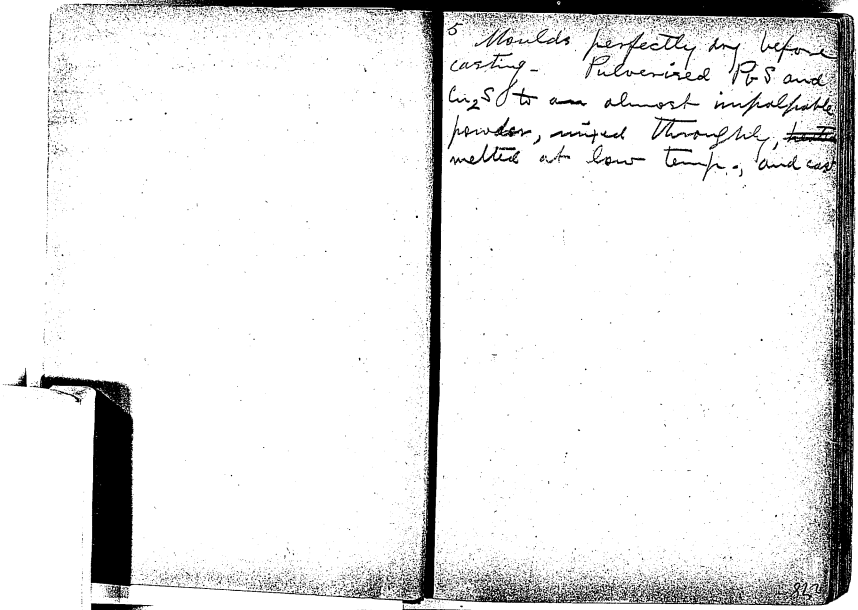
160
3
32.00

200 grains

16
2000
200 | 32000 (160
200
1200
1200
0000






Moulds perfectly dry before casting - Pulverized PbS and Cu_2S to an almost impalpable powder, mixed thoroughly, melted at low temp., and cast

Dry moulds — Poured [illegible] P & S Co's
Dry Iron, [illegible] at low temp. [illegible]
[illegible] and cooled

12

3 Removed bad portions and remelted [illegible] double sulphide at lower temp. If any reduction of lead occurred allowed time for it to settle at bottom of crucible before pouring.

Deflection through 200 Ohms with armature up, 20° ± 30'
Internal resistance .5° ± 1 Ohm

4 Heated moulds until perfectly dry. Removed bad portions from bars previously cast, remelted at as low temp. as possible, low red heat, and cast. Deflection through 200 Ohms, with armature up 30° ± 50'; internal resistance .7 ± 1.5 Ohms.

Lead Sulphide & Cuprous Sulphide

The fusing point lower than that of Cu_2S, which is the higher of the two

Alloy hardens on cooling, Cu_2S contracts

Fracture uneven, crystalline dark grey

Lead Sulphide & Cuprous Sulphide

239 PbS + 159 Cu_2S -

Melted together in covered crucible.

First bar cast gave deflection 20° to right = internal resistance .08 Ohm. Two bars cast at same time, each gave deflection of 20° right. Internal resistance, one .14, the other .2 Ohm

Cast several bars, patches of metallic lead, or a lower sulphide formed in bars. Perhaps caused temp. too high

4 = Bar

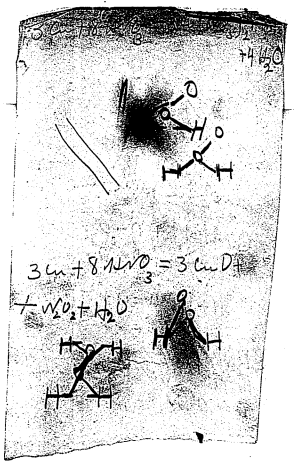
Bars cast with Cup S containing traces of S. Simply melted and cast into moulds. Deflection 60° ± 70° ± 1°. Internal resistance of bars. 18 & 19 Ohms.

Gm 52

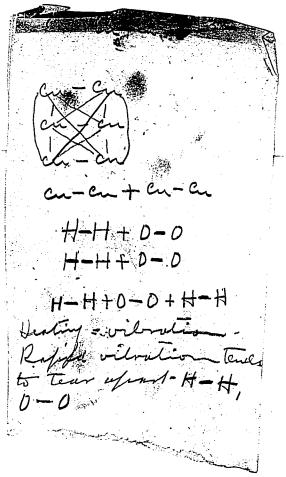
Metal Carrier + Sol. of S, moderate
heat, fuse, placed in crucible,
covered with NH_4Cl – Exposed
to red heat – Result, amor-
phous sulphide? Placed
in crucible with excess of
S and covered with NH_4Cl &
Exposed to red heat.

Res. 1 – $Sn\,S_2$ –

[ITEM FOUND IN BOOK]



[ITEM FOUND IN BOOK]



[ITEM FOUND IN BOOK]

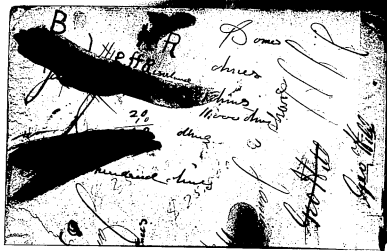
will not now be as in
the first case
If the ground is it was
imaginary apply the first
force then the third
left the second now
remove the first and
the position of the mol.
will not be as in the
second case
Applying this to mole it
is easy to see how the
same impression or
impressions will not
give rise to the same
thing take in every case

a group of mol. a
force is applied to one
it produces a certain
change. a force is applied
to another it produces
a different change.
Let the last force be
moved and the mol will
resume the position
position they were
under the first force
Let a third force be applied
the first force removed and
the second force applied let
the third force be removed
and the first force applied
the position of the molecules

Menlo Park Notebook #41 [N-79-12-09]

This notebook covers the period December 1879-March 1880. It contains tables relating to tests on experimental lamps, numbers 141 to 973. Most of the entries are by Francis Jehl, but there are also occasional notes by other laboratory workers. Related material can be found in Menlo Park Notebook #19. The label on the front cover is marked "Lamps" and "Electric Light." The book contains 284 numbered pages.

Missing page numbers: 33-34, 121-122, 159-176, 247-248, 253-254, 257-264, 267-270, 273-276.



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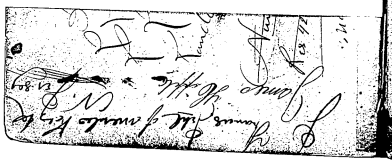
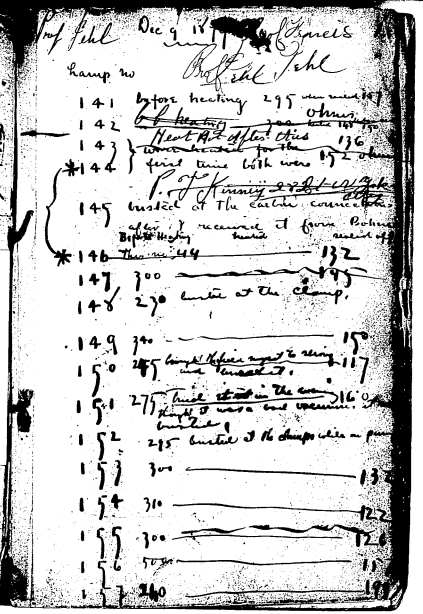
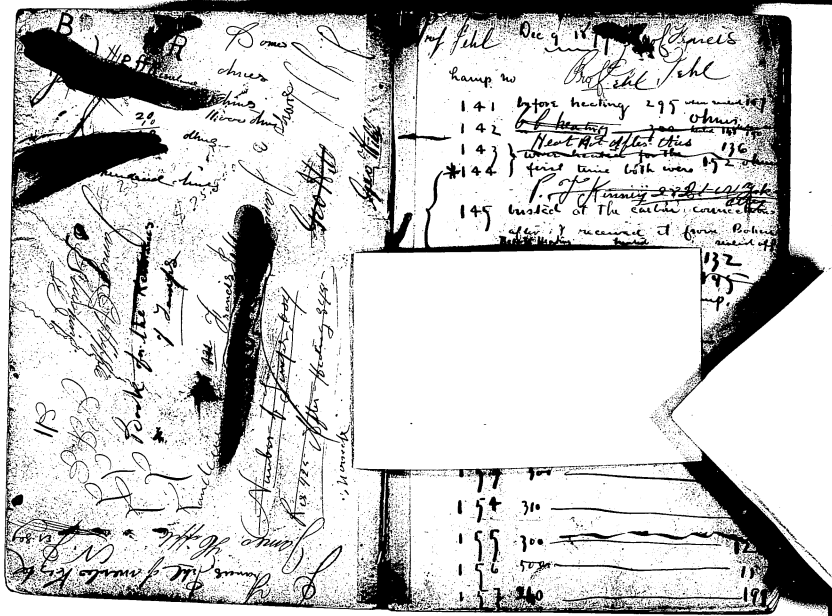
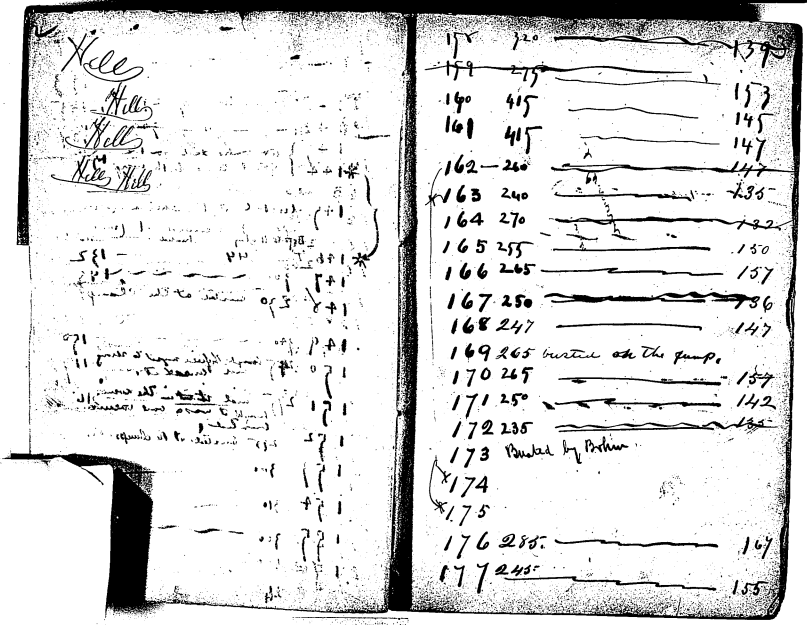
....., 189.



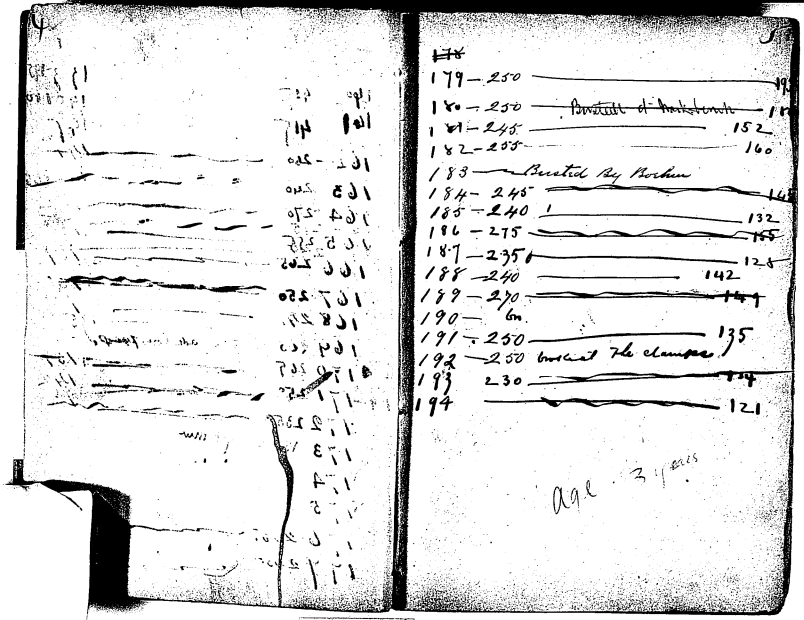






Hell
Hills
Hell
Hell
Hill

158	220		139
159	275		
160	415		153
161	415		145
			147
162	260		147
163	240		135
164	270		132
165	255		150
166	265		157
167	250		136
168	247		147
169	265	burnt on the pump.	
170	245		157
171	250		142
172	235		135
173	Bowled by Bolton		
174			
175			
176	285		147
177	245		155



179 — 250 — 195
180 — 250 — Bonfield & Parkhurst — 1[illegible]
181 — 245 — 152
182 — 255 — 160
183 — Beaten By Norton
184 — 245 — 146
185 — 240 — 132
186 — 275 — 155
187 — 235 — 128
188 — 240 — 142
189 — 270 — 144
190 — 6m.
191 — 250 — 135
192 — 250 Lost at the dumps
193 — 230 — 124
194 — 121

age 31 yrs

Lamp No. 147 145 Ohms cold

Yellow

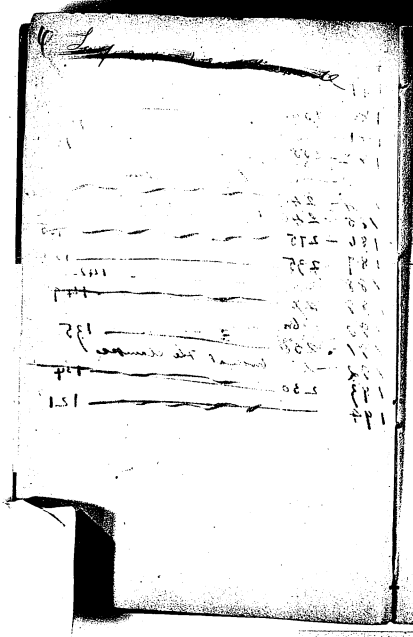
87 Volts

56 : 263 :: 21.4 :

1.33041
2.42266
8.28896
2.01001

102 Ohms

1.9317
1.9397
1.9910
1.6464
3.3188



8

Lamp No. 147

92 Volts

220 / 122 Volts Machine

60 on resistance

276

60 : 276 :: 21.4 : 98.44

1284

456

4.6

98.44 Ohms

1.9638

1.9638

1.6464

8.0070

3.06810

.5145

.9375

3800 ft. Vs.

8.66 for H.P.

Lamp No 146

64 / 259 / 86 Volts

64 : 259 :: 21.4 :

1.3304

2.4133

8.1938

1.9375

.9345

1.2426

8.0635

1.5979

86.6 Ohms

3780 ft

68.5 / 272 / 91 Volts

68.5 : 272 :: 21.4

1.3304

2.4346

8.1643

1.9293

85 Ohms

10

Lamp 146

82.6 Volts

61

248

61 : 248 :: 21.4

1.3304
2.3945
8.2147
29396

87 Ohms

.9170
1.9170
1.6464
7.0604
2.5408

3470 ft. lbs.

.85
.9777

9.5 for H.P.

Avg. 85 Ohms hot

11

~~145 105 135~~

Lamp .162

147 Ohms

88.6 Volts

58

266

58 : 266 :: 21.4

1.3304
2,4249
8.2364
1.9919

104 Volts

104 Ohms

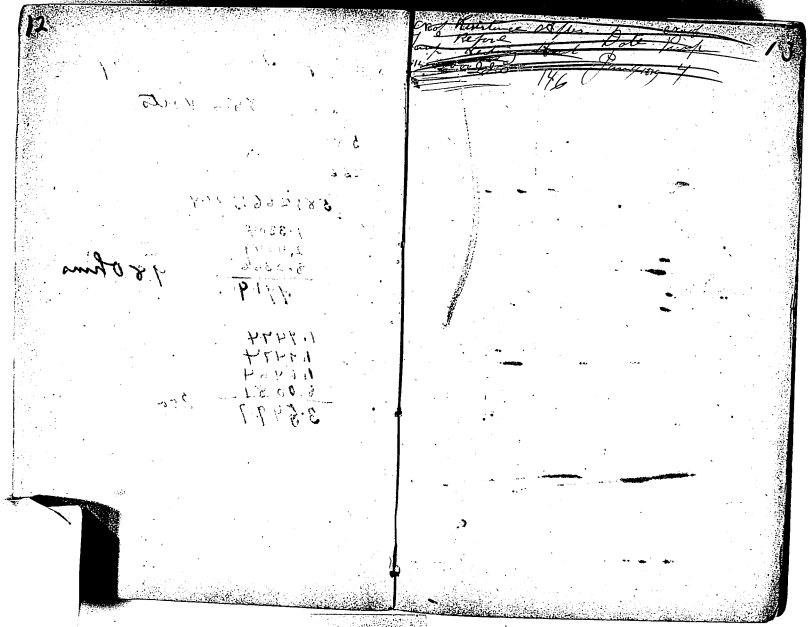
147 Ohms

98 Ohms

343 Volts

1.9474
1.9474
1.6464
8.0081
3.5497

3500

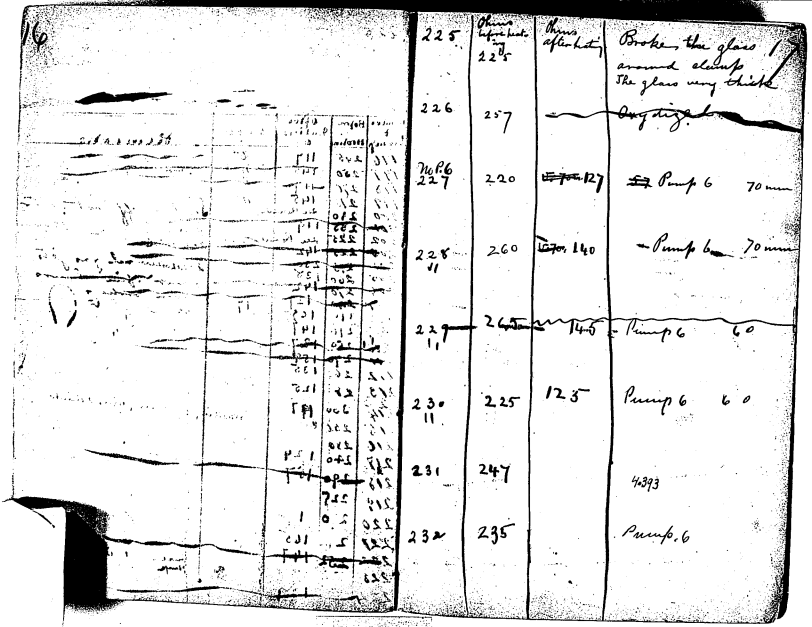


14

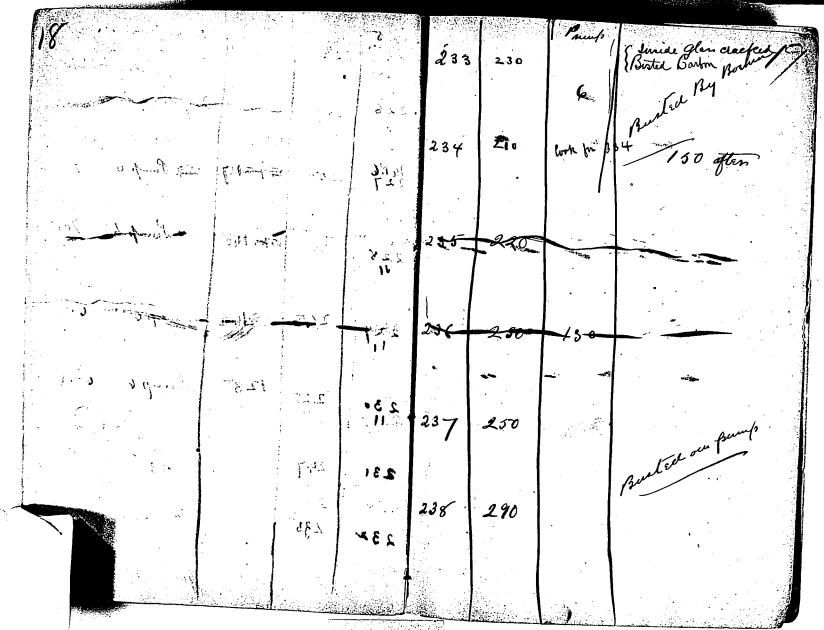
15

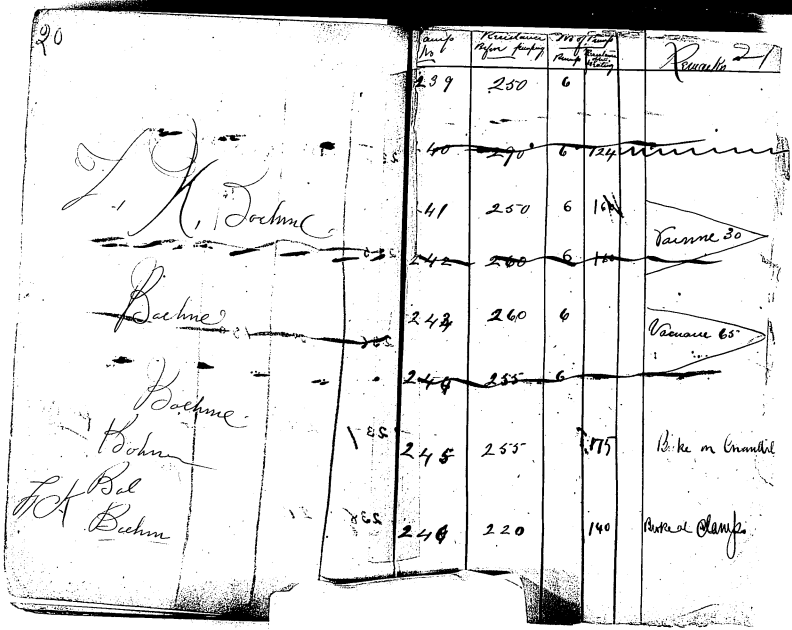
Numbers of Beams	Bearing Readings	Offset Reading Obs	Date	Remarks
196	265	111	15th	
197	250	145	"	
198	270	"	"	
199	270	145		
200	270	111	"	Finished off last of this
201	285	119		
202	225	142		
203	225	142		
204	245	134		
205	260	138		
206	270	142		
207	290	121		
208	270	163	17	
209	270	147		
210	250	137		
211	250	137		
212	260	135		
213	250	125		
214	300	197		
215	250	Broke by		
216	250			
217	240	124		
218	290	167		
219	225			
220	290	1		
221	272	165		
222	252	147		
223				
224		109		

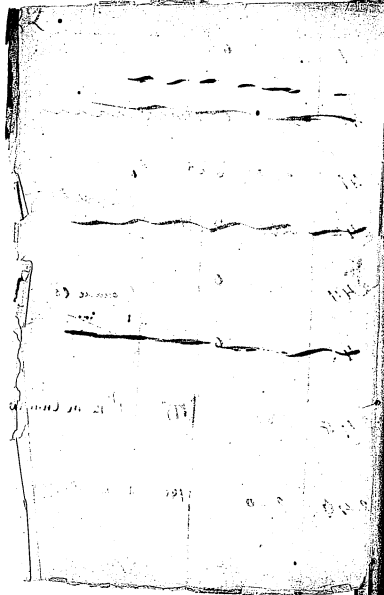
Finished off the compass traverse



225	225		Broke the glass around clamp The glass very thick
226	257		Dry trial.
227	220	~~127~~	~~Pump~~ Pump 6 70 mm
228	260	140	Pump 6 70 mm
229	245	140	Pump 6 60
230	225	125	Pump 6 60
231	247		4393
232	235		Pump 6

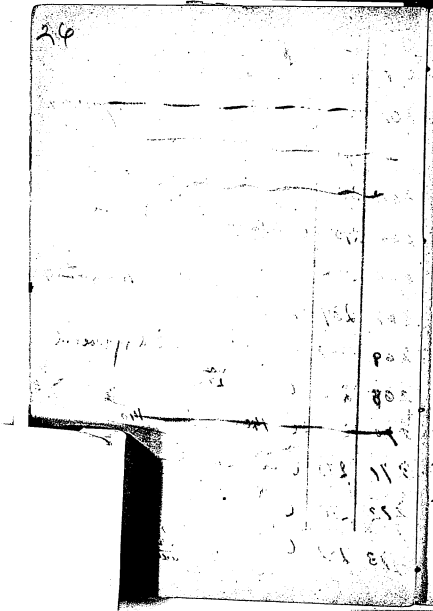

18
233
230
Pumps
Female Glen cracked
Porter Barton
234
230
Work for 234
Bucketed by
150 often
235
240
236
240
15
237
250
Bucketed on pumps
238
290


90
Lamp No.
Resistance per lamp
No of Lamps
Remarks
239
250
6
240
250
6
124
241
250
6
124
Vacant 30
242
250
6
100
Bechme
243
260
6
Vacant 65
Bechme
244
255
6
Bechme
Bohm
245
255
175
Broke in Chandel
Bal
Bechm
246
220
140
Broke at Clamps



No. of Count	Reading Prior to Pumping	No. of Pumps	Reading after Pumping	Remarks
247	260		135	
248	260		135	
249	250	6	160	Bubble up pore leaks. Vacuum 65 — Vacuum lost in Pump
250	290	6	125	" 65 "
251	280	6		Vacuum lost taken
252	320	5		
253	280		140	
254	290		150	
255	250	6	200	another sample run from Burke 5 Oil to Emulsifier
256	250			Vacuum
257	290	6	160	
258	250	6	160	Vacuum 66
259	270	6	150	
260	260		129	Burke after Pump

Number of Pump	Resistance before Pumping	Number of Men Pumping	Number of Men Changing Pumping	Date	
261	—	—	—	—	Bunker by Boehm
262	—	—	—	—	Bunker By Boehm
268	270	6	147		40 Vacuum
267	300'	6			
265	275	6	Carbon broke		48 Vacuum
266	234	6			Carbon broken on pump
267	239	6			
269	—	—	—	—	Busted by Boehm
268	270	6		27	
270	240	6	140		Vacuum 140
271	270	6			
272	270	6			
273	182	6		29	Busted on pump with burnt out Carbon



Number of Lamp	Resistance before Ramping	In Minutes	Resistance after heating	Flow	Remarks
274	280	6		Nil	Vacuum 60
275	~~275~~		172		~~Resistance before Ramping~~ Query not to be correct
276	280	4		"	
277	280	4		"	
278	295	5		"	
279	295	5		"	
280	255	6		30	
281	250	6		"	
282	245	5		"	
283	262	5		"	
284	245	4	Ring Carbon	"	Arch formed at close
285	158	4	+	"	
286	185	6	+	"	
287	177		+	"	Removed by Mercury

Pump	Reading after pumping	Hr. Pumped	Reading after filling	Remarks
288	273	6	6	Brushes cleaned
289	275	6	Bubbles	in "glass up platform cover
290	300	Cracked		in inside "glass
291	295	6	30	Pump 40
292	—	—	—	Broken before testing
293	—	6	"	Pump 40
294	285	6	"	
295	345	6	15	" Pump 40 in place
296	250	5	"	Brushes cleaned on pump
297	342	5	"	
298	—	Inside glass broken by crack		
299	—			
300	284	145	2	Pump 30

No. of Exposure	Number of Spectrum	Width of Spectrum	Number of Bands	Distance from Centre	Width of Band	Remarks
301	229	6			2	Iron
302	361					
303	265					
304	226			141		
305	255					Back glass exp.
306	250	6		157		
307	220	6				
308	242					
309	255					
310	249			140		Iron
311	244			141		
312	240			135		
313	289			158		14 Millimetre Iron
314				195		

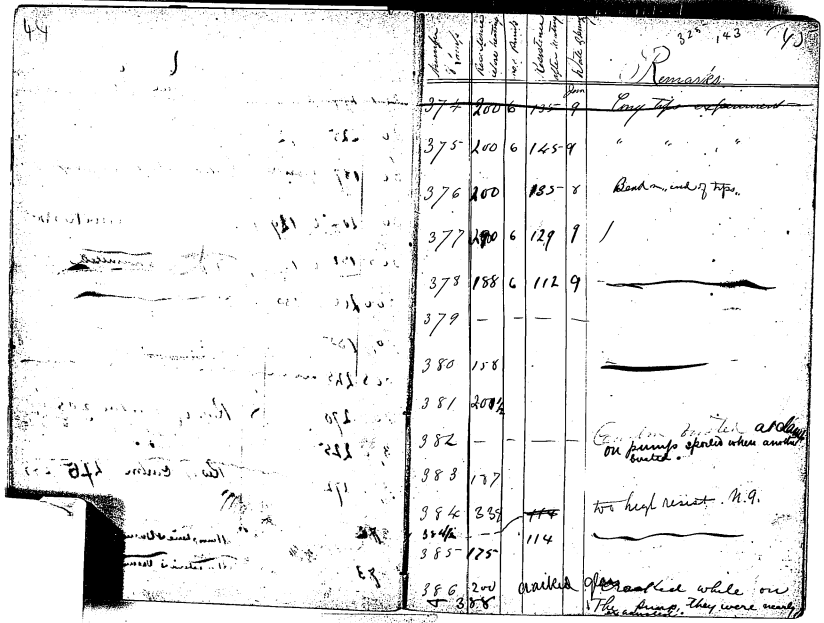
No of Sample	Resistance before heating	No of grains	Resistance after heating	Date	Remarks
315	345	5	250		
316	286	5	185		
317			144		
318	290	6	152		
319	245				
320	270	—	—		Glass cracked between clamps
321	215	—	—		Broken down Resistance low
322	264				
323	264		Ring Carbon		
324	—				
325	270	1/4	142		

No. of Sample	Resistance in ohms per foot	Resistance in ohms per foot	Weight	Remarks
326	245		"	
327	290		"	
328	240	131	"	
329	250	146	"	Jan 14 Commenced
330	250	140	"	
331	200	145	"	
332	207	112	"	
333	235	137	"	Carefully annealed
334	220	145	"	
335	201	113	"	Broken 195 ft.

Lt. of Pressure	Resistance after passing	Lt. of Pressure	Resistance after passing	Velocity	Remarks
336	204		117	0	171 ~~Barometer 4~~
337				5	Light Resistance
338	240		—	4	Via one end of the heavy wide mould made
339	240			4	Level - oiled - Barometer reads Thermometer 225 - Atmo
340	230		133	4	
341	250			Jam 6	
342	230		127	6	Vacuum ~~2a mark from top~~
343	260		147½	6	" " " "
344	170			6	Experiment - form Barometer
345	107		133	6	Commenced Exp
346	195			6	Cracked white formed together
347	210		127	6	
348	205		131	6	

No of Bunch	Resistance before pumping	No of Bunch after pumping	Resistance after pumping	Days	Remarks
349	240	6	192	6	Resistance of cultn. 220
350	200	6	129	6	" " " [illegible]
351	225		117		" " 197
352	223		122		" " " 210
353	245		135		
354	216		134		" " " 255
355	267				Cavities badly " 228
356	223				Enumerated Trip
357	219		168	7	Enumerated Trip
358	202		130	7	Enumerated Trip
359	189	10	6-142	7	Cavities broke before pulling out of completed (15 Resistance after)
360	229	6	125	7	Enumerated Trip

Number	Resistance	Resistance	Insulation	Remarks
361	209			Resistance of Carbon 200
362	225	172		207
363	187	glass cracked		Copper wire Carbon broke on pumping
364	204	6	129	cracked glass between wires 1/5 inch
365	182	6	120	Tip enamelled
366	200		150	"
367	185			" Cracked on pumping
368	225			"
369	270		8	Res. of Carbon 205
370	225	—	—	"
371	172			" Res of Carbon 276 245
372	284	130		Humphries Vacuum Pump
373	236			Humphries Vacuum Pump



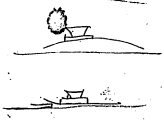
Number of Target	Main Channel Main Timing	Main Pressure	Chamber Pressure	Hitz Pressure	Remarks.
374	200	6	135	9	Lay tops commenced
375	200	6	145	9	" " "
376	200		185	8	Boat on end of tops.
377	200	6	129	9	/
378	188	6	112	9	
379	—	—	—		
380	158				
381	200½				
382	—	—	—	—	On pumps opened when under water.
383	137				
384	339				high recoil. N.9.
384½	—		114		
385	175				
386	200		marked		Broached while on the pump. They were nearly
30.8					

Number of Round	Resistance before Annealing	Resistance after Annealing	Remarks
387	380		No good tunnel resistance
388	170		cracked glass see 386.
389	190		
390	220		
391	732		broke on pump running barretts hunting
392	235	130	Carbon heated too much see 391 Barretts
393	225	124	Too high ~~H.V.~~
394	180	105	
395	191		
396	232		
397	287		Res. too high ~ C.
398	202		

399	185
400	200
401	185
402	167
403	200
404	

Remarked Disp
Remarked

Number of Lamp	Number of subscription	Number of pamphlet	Bunch	Bills	Remarks
399	185				
400	200	124	5	12	
401	185	118	5	13	
402	167				
403	200	142			Remarked Disp
404	257		6		Bastin and Phillips 6
405	222				
406	225				
407	229				
408	200				
409	186	X			
410	184	117			
411	185	132			
412	200	-	6		rec'd here check
413	200		6		
414	192	147			



No of Sump	Remarks Before Pumping	Remarks after pumping	Pumped	Date	Remarks
415	184				
416	172				
417	190	131			
418	192				Taken down by Mr. H. Before Rec. Inspection
419	136	128			
420		154			
421	215				
422	178				Bursted on pump
423	200				
424	—				P Platinum clamps Aluminium clamps
425	—				Platinum clamps Aluminium clamps
426	—				Aluminium Clamps
427	181	188			
428	203	146			

52

53

Number of Experiment	Pressure	Temperature	Volume	Time	Remarks
429	250			8 am	
430	239				
431	172				
432	~~175~~	152	4	18	counting experiments attempted 432 Carbon Bisulphide #32
433	~~[illegible]~~				
434	180				
435	220				
436	201				
437	212				
438	200				
439	201				
440	185				
441	200	155			
442	207				

Number of Sample	Number Balloons Inflated	Number Balloons Ruptured	Point	Wide	Remarks
443	190				
444	174				
445	198	145			
446	200				
447	200	157			
448	200	175			
449	180				Busted
450	200				
451	220				
452	134				
453	218				
454	209	158			
455	187				
456	182				
457	195				

No of House	No of Inhabitants	No of Children learning	No Journeymen	Work	
453	182				
454	195				
460	175				
461	210				Door Vacuum
462	483				
463	201	167			often burning 3 hours least at a House also 466
464	200	144			
465	210				
466	210	146			see 463
467	181				
468	220				
469	182				
470	[illegible]				
471	175				
472	211				
473	195				
474	193				

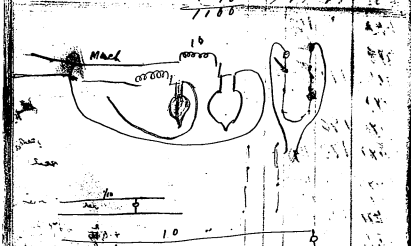
58

59

No of Sample	Wt. after drying	Wt. after sieving	Remarks
475	193		
476	190		
477	196		
478	172		
479	185		
480	220		Root [redacted]
481	192		
482	176		
483	189		
484	210	142	
485	182	125	
486	176		Carom bottle by being Taking from the road [illegible] brooks near This clumps after it was [illegible] due to [illegible]
487	426		
488	170	136	
489	-		
490	180	130	
491	201	160	

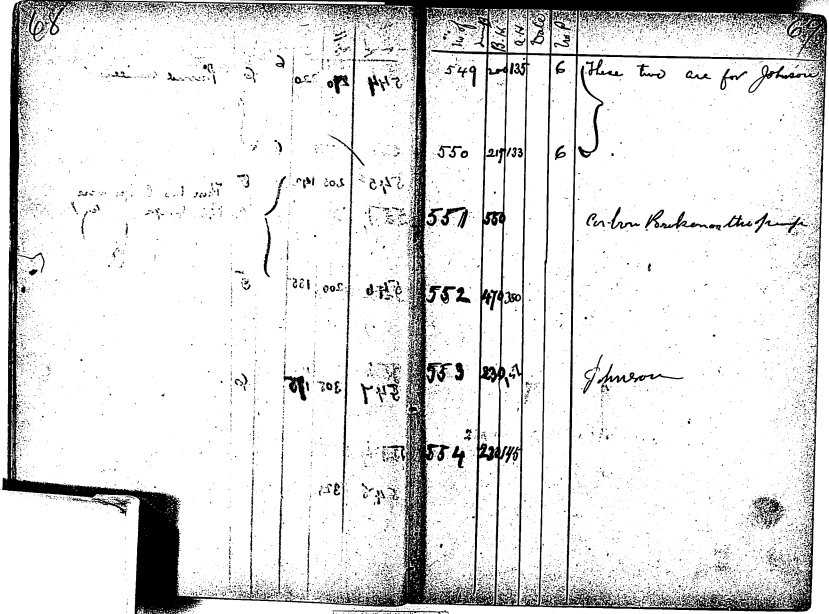
No of Pumps	Rev per minute	Rev per minute	Ducks	Pumps	Remarks
492	174	142			
493	220				Was broke when I received it to be broken. T.B.
494	177	127			
495					Carbon Broke
496	196	143			
497	177	140			
498	165	145			
499	190	155			
500	80				This was Chat + 501 was Chat fine thread of nipples the current was to strong for them so they broke
501	40				
502	195	128			
503	200	157			broke about six o'clock Jan 28 1888
504	148				There were on Pump No 5 and were ordered by the air getting into the Pump.
505	200				
506	210	150			
507	200	135			
508	220	159			
509	235	165			H.R
510	204	136			
511	210				Packing broken down by Mr Low to be fixed

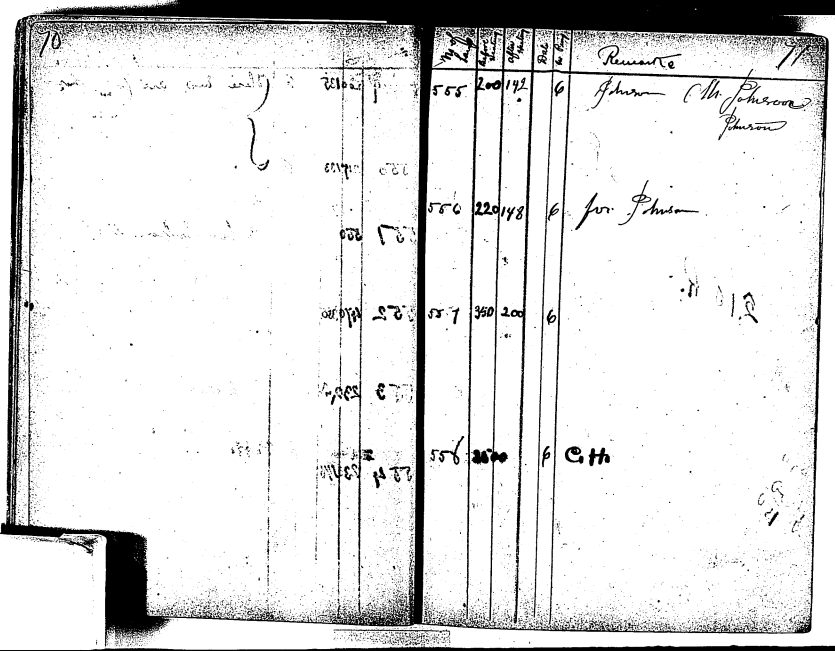
62 10

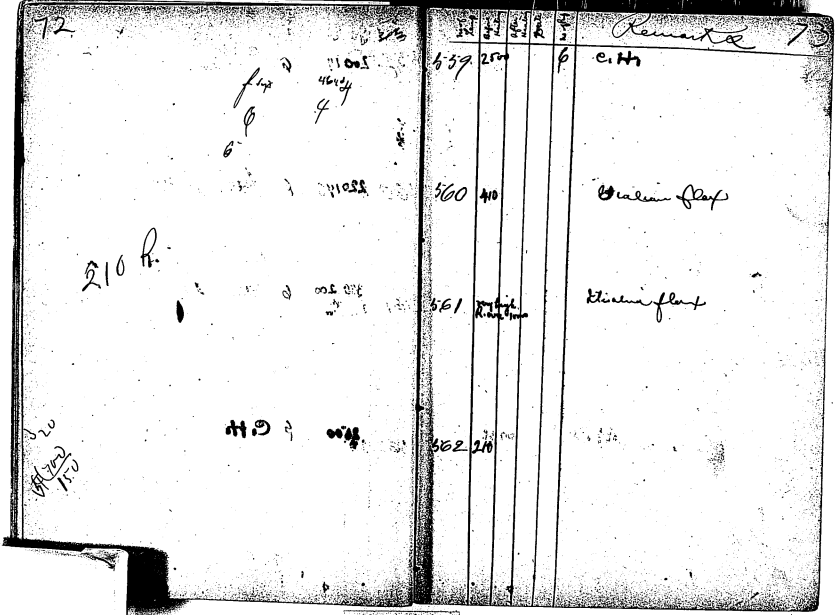

Mack
10
Sand
10
Sand
Sand
Mason
Sand
Mason
Sand
Mason

No of Lamp	R. H. H.	H. A. H.	Back	Rank	Remarks. Training Jobs
535	220				
536	185	133			
537	640				manilla fuse
538	600				manilla fuse. This one, the fuses crack and burned at 2 No 538
539	210	135			manilla paper
540	220	150			manilla paper. burned after being up about 8 hours.
541	800	570			The two burned after Light there on the main wire for testing
542	1100	770			
543	270			6	Pressed manilla Burned by Boks while testing them on

Mus. Lamp	B.H	W.H	Date	Lamp	Remarks
544	290	220		6	Pressed moulded
545	205	142		5	These two lamps were of this Shape
546	200	135		5	
547	305	190		6	
548	325				







No. of Pump	B.H.	A.H.	Date	Name of Pump	Remarks
563	190	154			
564	265				
565	191				Rejected pump / taken off the Pump by Cook (the boys that they worked) but as Bolton broke them open to put them on another pump, the Overseer destroyed them.
566	800				Work note pumped (one) 865

76

Time	Min	Sec	Time	Time	Remark
427	220	165		6	This one when I measured it was 260 then I measured it for the copper wires (it before was in a shield) and it was 165 / showing back connection.
468	33				~~Manila~~ Manilla Hemp fiber Twine paper ends are formed at the end of one of the clamps
469	282				Band note pressed Mr Edelman tried it. he put the current on middle one got a fog got and after a few minutes it broke at the clamps, one one being formed
470	29				(Guess it is hemp twine lamp black also) so was the paper wrinkled)

571	360		in lamp. time paper ends 2 Bulbs at the end of the clamps when the current was put on
572	202		are formed at one of the clamps.
573	165	122	
574	184	137	

575	220	179		Last a very good vacuum on this pair but they did not give much light.
576	2[illegible]	[illegible]47		
577	210	145		
578	200	165		
579	220	104		
580	215	147		
581	175	125		
582	200			paper split and the fibre pressed in same
583	300			

	Rev's	Rheost	DATE	Remarks
584	335			Fibre threaded through and pressed together tight
585	359			Same
586	225/64			
587	203			The glass that held the wires crack while on pump
588	210		6	twisted fiber
589	200		6	twisted fiber are at the clamps

Vol.	AMP	RES	PATH	SITE	PUMP	Remarks
	590	510			6	* Carbon Rube in the lungs of the one of the clamps as are transformed fiber. New Style
	591	510			6	* Carbon Rubber at the clamps
	592	550	467		4	*
	593	520	345		4	* New style clamps fiber
	594	600	295		6	*

No.	RES.	BATH	DATE	PUMP	Remarks
675	405	208			
676	205				
677	230				
678	185	133			
679	550	350			(fiber) graphite clamped) cutter 01 Wire to clamp — clamp packed a wire — Centre packed in with small pieces —

No.	Time	Pt.	Wire	Remark
600	650	1/0		Fibre (Clamps of Graphite drilled and punched w wire) .01 wire to clamp. Carbon wedged in with small piece
601	1/80			Pt clamps with a little plumbago in the holes. .020 wires when the current was put on ~~with~~ for the first time it was taken out of the clamps
602	720	95		.010 Wire — Graphite clamps — Clamps drilled and punched on wire — carbon wedged in with small piece
603	470	280		~~Carbon~~ (Graphite clamps —) Wallace Carbons .010 wires — Carbon Platter or wedge Carbons wedged in with small pieces
604	820	450		

Lamp No.	Bulb No.	Watts	Date	Remarks
606	669	3/0		Wallace Carbon clamp soaked in olive oil
				10 thousand Wire Carbon Wedged in by small Pieces
606				
607	520	420	6	Fibre (manilla) — Lignum Vita clamps Carbonized with fibre
608	800	585		Fibre (manilla) Lignum Vitae clamps Carbonized with fibre
609	687		6	Fibre (manilla) Lignum vitae clamps Carbonized With fibre.

No.	Line	B.H.	A.H.	Date Pump	Remark
610		172	129		
611		210	147		
612		210	147		
613		212	133		
614		215	158		

Rod Lamp	B.H.	A.H.	Date	Pump	Remarks
615					Knocked off Table while being measured. cardboard Horseshoe. platinum clamps. which is d-d carelessness.
616	200	130			
617	230				
618	220				
619	222				

96

97

No. of Lamp	B.H.	A.H.	DATE	Pump	Remark
620	190	130			
621	191	150			
622	548				
623	470				Manilla fibre. – Small excess nut clamps – wide apart – clamps pushed on platinia wires – $\frac{1}{1000}$ wires – an arc at the clamps
624	550				Manilla fibre – Lignum vitæ clamps pushed on wire – $\frac{1}{16}$ apart (the current [illegible] when put on, put a clamp out of the R[illegible] wire

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Ref. Letter	B.H	A.H	Date Pump	Remark
625	220.			Broke on the first Burtsel the small hole in casing
626	358	267		Ryan Vice
627				
628	200			Air are at the clamps.
629	210	127		

99.

Log of Core	B.H.	A.H.	DATE	Pres. Pump	Remarks
630	252				Cocoa nut Clamps manilla fibre $2\frac{3}{1000}$ Wire
631					manilla fiber Ligneum Vitae $\frac{3}{1000}$ Wire wire burnt with batteries & glass bulb inside cracked by melted wire when current was passed over it
632					Ligneum Vitae Clamps $2\frac{3}{1000}$ Wire to heat clamps manilla hemp fibre it Broke after burning 2 minutes
633	500				manilla fiber Cocoa nut ~~cable~~ ends new wire clamps
634	420				

No. of Lamp	B.H.	A.H.	Date	Dur. of Pump	Remarks
635	650	342			
636	645	410			
637	370				Cocoa nut clamps Cocoa nut Fibre ~~Spirit not got at Vacca~~
638	—				Manilla fibre 1000 Hank 1 in long 20 ~~Cocoa nut~~ Lignum vita Clamp
639	—	300			Cocoa Nut Clamps.- Cocoa Nut Fibre.-

No. of LAMP	B.H.	K.H.	PLATE	PUMP	Remark
640					Cocoa Nut - clamps. Cocoa Nut - Fibre.
641					Cocoa Nut - clamps. Cocoa Nut - Fibre. inside glass Bushe on the pump Glass Ring heated several times
642	210	144			three time Rim on the glass New paper
643	223	162			New paper
644	456				Card Board 2 for each Platinum clamps.

No. of Lamp	B.H.	J.H.	DATE	PUMP	Remark
645	200				
646		379			Cocoa Nut Clamps and Fibre. " " " " — Dodigeon —
647					Cocoa Nut Clamps and " " Fibre Broken by Hammer
648					Straw Paper 15/1000 Two Sad Spots.
649					Straw Paper 15/1000

No of Lamp	B.H.	A.H.	DATE	PUMP	Remark
645	200				
646		379			Cocoa Nut - Clamps and " " Fibre. - Discharged -
647					Cocoa Nut - Clamps and " " Fibre Broken by Hammer
648					New Paper 15/1000 Two bad spots.
649					New Paper 15/1000

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No of Stand	B.H.	A.H.	DATE	PUMP	Remark
650		450		G	Manilla Hose Covered Check Hose in Case before Lantern 7/1000 thick " "
651	250	250		G	Small Loops ~~651~~ 659 Cut from 1/8 Paper- high Resistance Coil put on the pump
652	290	230		G	
653	720			G	Small Loops made from same as 654.655- measure about 60 ohms Resistance put on the pump
654	730			G	Bad Joints in Carbon registered with 655

109

No. of Point	B.H.	A.H.	Date	Pump	Remark
654	750			℄	Two larger loops (654 + 656) cut from May number 016 paper — 6000 Ohms not able to accurately push high resistance wire past stem on the jumps.
646	740			℄	they measure above 6000 ohms, but put them on & see if jump will bring them down .015 paper
657					Made from .015 paper Uncalendered - and as they are about 6000 Ohms we put them on jumps to see if they will come down. GSB 13-1881.
648	750				Small loop - 300 R. coiled all over with Aluminum finely powdered and mixed with alcohol - put on with brush GSB 13-1880
649	175				Small loop made from .015 Uncalendered paper to be shown in large light at Ex.

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No of Ex	B.H.	A.H.	DATE	No of Pumps	Remark
660		78			Bass Fibre - 3in long, 014 thick nearly rotted - Shrunks -
661					
662		230			
663					Broke at the clamp on pump at the first heating
664	395		Feb 14	11	Rice straw, Cocoa nut clamps.

No of Lamp.	Beyond Marking	After Heating	Date.	Pump.	-Remarks-
665	299	—	Feb 14	4	Small loop - from pressed paper - coated with Zirconium Ox.
					Leak in inside bulb. 4
666					Same as 664 Small loop from pressed paper about 250 Ohms coated with Zirconium Ox.
667	320			6	Thrown out [illegible] on filament [illegible] Broke [illegible] Tried in N and exploded
668	260	R175		6	This one was put on the pump on Upton Wood & part B in it, but it leaked, was [illegible] put in new bulb
669	R.250	160			Smoked over sulphur Old small loops from 6½ M-
670	260	166			Old small loops made from 6½ M - about 250Ω

W. J. Fannin

No of Lamp	Barrel-heating	Stirrup-heating	Date.	Pump.	-Remarks-
671	142	93	Feb 17	4	Ordinary Small Loops Looked in Sugar. Glassy - funnel shape
672½	143	81.		6	first two Sugared
673	113	80.		6	the same as 672½
674	87				Small sugared before cutting. This Lamp was used for Nitrogen Experiment carbon broke after some successful Exts.
675	77	73.	19.	4.	Small sugared before cutting. All stuck together see 13's book

No. of Pump.	Before Heating	After Heating	Date.	Pump.	-Remarks-
676	101	70			Small sugared after cutting.
677	98				Small sugared after cutting. on side globe broke on the pump with high vacuum
678	87	61			Small sugared after cutting.
679	95	65			Small sugared after cutting.
680	17.3		Feb. 18.	4	Small. crocs not shell.

Hammer

No. of Lamp	Before Heating	After Heating	Date	Pump	Remarks.
681	24	57	Feb. 18.	4	Small loop, sugar coated before cutting. Carbonized between nickel plates.
682	202	103			Broke while getting Stability Put in new bulb. The same as 683
683	92	60			Small loops, 1/4 Carbon
684	334	290			Bunch of Jute Fibers
685	520				Bunch of Jute Fibers

No. of Lamp	Before Heating	After Heating	Date	Name	Remarks
686	371.	320			Jute fibre bunch
687	337.	295			Bast fibre .4 in. Lng. .014 thick.
688	263				Bunch of Jute fibre Carbon does Not split all over
689	440				Large bunch of fine Jute [redacted] Bad Carbon it broke not give a good light
690	143				Small Jute fibre Arc formed at clamp + carbon broke

No. of Lamp	Before Heating	After Heating	Date	Pump	Remark
691	115				Large Braided Jute 3 Strands
692	181	150		f	Bast Fibres 5 in X .014
693	156			f	Jute Fibre, plaited 3 Strands, Core formed at clamp at first Heating
694	223				Bast Fibre 5 X .014
695	119			f	first 693 Jute Fibre, plaited 3 Strands, Core formed at clamp at first Heating

X 188 Last Lamp

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No of Lamp	Resistance Before Heating	After Heating	Date	Pump	Remarks
696	163	136		E	Large Bass Fiber
697	Given wrong number by mistake			E	Regular Carbon Broke while being put on pump by J.K.L.
	130				Jute fibre, 3 strands plaited.
698					3 large loops uncalendered Japan .010 thick soaked in sugar (weak sol) Res. after Carbonized 169 Ω
699	160			E	Regular Carbon Nitrogen Ex Broke on the pump When Heated
700	169	147			Large Loop, uncal. Ladyrd paper .010. in thick, soaked in weak sol, sug. before cutting.

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No of Lamp	Before Hearing	After Hearing	Date Pump	Remarks
701		145		Large globe Brooklyn Lighting Co on the floor. Large Arbed impressed [illegible]
702	293	190		Bond-Fibre 5"x.014
703		850		Sir Manilla Fibre .002 thick - laid straight together -
704	470	400		Bast Fibre -5"x.014
705		225		Bass Fibre

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132

133

No of Jump	Before Hearing	After Hearing	Date	Pump	Notes
706	[redacted] 156	141			Regular Carbon Buzzard
707	160	142			Regular Carbon Buzzard
708	180	144			Regular Carbon Buzzard
709	185				Regular Carbon Buzzard [illegible] oxygen. When Heated on the jump
710	180				Regular Carbon Buzzard Died in M. Carbon about one minute at atmosphere pressure Carbon Bubbled on the Jump

No of Lamp	Before Heating	After Heating	Wake Pump	Notes
711	160			Regulus & Engraved Oxydised and Broke the carbon filament on pump at 5 hours
712	170			Regulus & Engraved Oxydised and Broke the carbon filament on pump about 5 hours
713	170	143		Regulus & Engraved Bad Spot in Carbon
714	180	135		Regulus Engraved
715	180	112		Regulus - Engraved

No of - Lamp.	Before - Heating -	After - Heating -	Date -	Pumps	- Notes -
716.	200	146			Sugared Rigales -
717.	200				Sugared Candle about 200 Chains.
718.	114		Feb. 23.	4	Jute Fibre Plaited Platinum Wire fastened to Jute By Winding Round with Jute the ends boiled in Sugar Carb-63 Clear.
719.	206				~~Carb 64 Bass Fibre - SX 011 Steeped for Three hours~~ Carb 64 Bass Fibre - SX 011 - Soaked in Sugar Steeped Before Longing for an hour Knobs Where carrots was put on the first time
720.	109		Feb. 13.	4	Carb 66 Jute Fibre - Plaited wet Steeped By Heat ends cut and sugared Are formed at lamp.

No of Temp.	Before Heating	After Heating	Date	Temp.	-Notes-
721.	105				Carb-62 Platted Jute Fiber soaked in thin Sugar-water then the Clamps Cabbage it — Steam at clamp feet Steam heating 17 Celsius with Hot
722.	125				Large Loops Cut from 1010 — Sugared in Standard Solution
723.					Resistance very high and would not put on temp Bath Connection on Clamps Wall one Wire not Bobbed
724.	170				Large Loops Cut from 1010 Sugared in Standard Solution
725.	447				High Res, Large Loops made from Sugar Sol, 0 — Broken Carbon by Glass blown when put in Bath

No. of Lamp	Before Heating	After Heating	Date	Pump	Notes
726.					High Res. Large Loop made from sugar pol. C = Carbon Broken by Glassblower
727.	275	160	Feby 23		(Exp. - 74 Cubs) Short Filter paper - ends soaked in fruit sugar. ~~and [illegible]~~ ~~[illegible]~~
728.	312.		Feb. 24.	H.	Regular Loop. New expand reduction are formed and inside of tube thus tested With high Vacuum
729.	182	136	Feby 24.	G.	Large Loop. — Burned With no2 Solution
730.	295	160	Feby 24		Large Loop - copper plated on shaft of Carbon

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No of Lamp	Before Heating	After Heating	Date	Rmk	~Notes~
731	155	123	Aug 15		No 5 Sol. Large Loop LN
732	172	135	Aug 15		No 5 Sol Large Loop.
733	242	186	Aug 15		No 4 Sol. Large Loop. LN
734	199	138	July 26	4	Regular - Large Loop - Soaked in Standard Sol. -1-2 - #4
735	197	137	July 26	4	Reg - Large Loop - Soaked in Standard Sol -1-2 - #4-

143

No of Jump.	Before Heating	After Heating	Date.	Pump.	Notes.
736.	197	208	July 26	6	Regular Carbon - Standard Solution.
737.	200.	141	July 26	6	Regular Carbon - Standard Solution.
738.	180.	130.	26.	4.	Regular - sugared
739.	200	144	Feb 26	6	Regular - Sugared
740.	193		Feb 26	6	Regular Sugared took off the pump could not get a Vacuum Cracked

No of Lamps.	Before Heating	After Heating	Date	Pump	Notes
741.	181				Large Loop. Soaked in No 14 Solution.
742.					Large Loop, Standard Sol - #4.
743.	185	150	July 28		Large Loop Standard Sol,
744.	171.			6	Large Loop. Standard Sol, on Side glass Bombe on the pump with a high Vacuum
745.					Large Loop Standard Sol, Broken Contact at clamp No fore current up from glass blower

No of Lamp	Before Heating	After Heating	Date	Pump	Notes
746.	213.	147	Feb 28	6	Standard Sol; Regular Carbons.
747.	255.	200	Feb 28	6	Regular Carbons Standard Solution
748.	250	172	Feb 28	6	Regular Carbons Standard Solution
749.	171.		28.	5	Same.
750.					Same.

No. of Tramp	Before Heating	After Heating	Date	Pump	Notes
751.	223.		Feb 28.		Large Coop, No. 4 Col.
752.	230.				Same Broke Rel[illegible] going on the Tramp it fell in & broke other Carbon
753.	200	5	Feb 28		Regular Carbon Standard Solution
754.	202	167	Mar 2	6	Same.
755.	228.		28	6	Same Had Spots in the Carbon it did not give a good light

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No of Tamp-	Before Heating	After Heating	Date- Tamp-	- Notes -
756.	211		Nov 28	Regular Carbon Standard Solution
757.	225			Regular Carbon Standard Sol [redacted]
758.	227		March 2	Regular Carbon Standard Sol
759.				Regular Carbon Standard Solution
760.	205	166	Mar 2	Borax Loaf Standard Solution #4.

150

154

No of Lamp	Before Healing	After Healing	Date	Pump	Notes
761.	200		Mar. 2		Regular Carbon Standard Sol Vacuum not up to highest on this long exhaust as sealed at 1.5 per cent Hg.
762.	210		Mar 2nd	4	Regular Carbon Standard Sol Bad deposit on the Carbon
763. A	200	160	Mar 2	5	Large Loop #4 Standard Sol.
763. B	229	176	Mar 3	0	Large Loop #4 Standard Sol.
764.	200.		Mch 2.	4	Large Loop, Standard Sol,
765.	223				Large Loop Standard Sol, are formed at claims + breaking one bulb oxydizing the other #766.

No	No of Lamps.	Before Heating	After Heating	Date	Pump.	Notes.
766	211					Large Loop N/64 Solution Carbon oxydized by breaking of Conducting bulb
767	172	153	mar 3	6		Large Loop N/64 Solution
768	266	190	mar 3	6		Large Loop N/64 Standard Solution
769	230		Mch 2	4		Large loop. Standard Solution
770	185	143	mar 2	6		Regulon-carbon 4 Standard SO

No of Lamps.	Before Heating	After Heating	Date.	Pump	- Notes -
771.	190	183	Mar 1	6	Regular Carbon 4 Standard Solution
772.					Regular Carbon 4 Standard Sol Carbon Broke when he Came to measure it about 1/2 of Broke
773. A	236	205	March 2		Edison Solution - Regular Loop - paper pressed Flat Soaked & pressed again
773. B	203	181	March 8		Standard Solution Regular Carbon.
774.	232	207	Mar 2		Edison Solution - Regular Loop - paper pressed before after soaking
774	230				Bulb cool on this pump High Vacuum
775.	243	210	Mar 2		Edison Solution - - Regular Loop - paper pressed before + after soaking.

8-57

No. of Lamp	Before Heating	After Heating	Date	Pump	Notes
776.	876			6	Large Carbon Old Bulb (Mold) High Resistance Coated with shiny substance and plumbago and sugar but not previously air dried. Bad results all over. Put on Burleigh pump.
777.	220			4	One large air bubble. Edison's new Solution. Sealed off. Could not get a Vacuum. Let pump run on the pump about ½ hours.
778.	35			6	Old High Resistance Carbon [illegible] Plumbago Sugar Solution and Oil. Carbonized Carbon [illegible] on the pump. [illegible] it has heated a few minutes.
779.	212	180	3'	4.	Edison's new enlarged Solution. Large Loop.
780.	205	170	2'	4.	Edison's new enlarged Solution. Large Loop.

38

80000 / 400,000

2000 / 12000

401 000.

250 000 / 2 000,000

28. 2 24

daily

365 / 12000 / 730 / 3 / 48 / 1. 600 000. / 365

2 million daily

365 / 730 000 / 730 000 / 730,000,000

730 000 / 6 / 4,380,000

177

No. of Pump.	Before Heating	After Heating	Date.	Pump.	Notes.
					Large Loop. Edeins Solution.
781.	195	149.	Mch. 4		
782.	240	196.	4.		Large Loop. Edeins Solution.
783.	237	190	mch 4	4	Large Loop. Edeins Solution has not got a good Vacuum could not get one
784.	203	173	mch 4	4	Large Loop. Edeins Solution Same as 783 Not a good Vacuum
785.	193	157	4	4	Large Loop. Edeins Solution

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No of Lamp.	Before Heating	After Heating	Date	Pumped	- Notes -
786.	164		Mch 4.	4	Linen paper 24 thickness pressed. Glass cracked & Carbon broken while being transferred. —
787.	248	176	mch 4	b	Small Loop .015 paper.
788.	248	176	mch 4	b	Small Loop .015 paper.
789.	255	187	mch 4		Small Loop .015 paper
790.	282	240	mch 4	b	Large Loop ~~Standard Solution~~ Carbon No 39. 18 Mult Tube Vessel Before Cutting

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Nos of Lamp.	Before Heating	After Heating	Date	Pump	Notes
791.	271.	210.	Mch. 4	7	Small Loop - 12 sheets tissue, pressed together before cutting
					On new pump.
792.	272	197	Mch 4	6	Large Loop ~~Standard Set~~ 18 sheet tissue paper pressed and cut together
793.	259	213	mar- 4		~~Standard Loop Regulos Carbon~~ Small Loop Regulos-Carbon
794.	268.	215	5.	7	Small Loop ~~Regulos Carbon~~ cut from .015 paper pressed to .007
795.	238	190	mar 7		Small Loop Regulos-carbon

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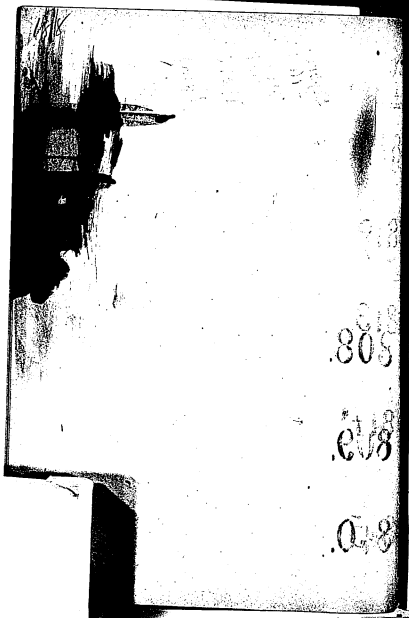
No. of Lamps.	Before Hearing	After Hearing	Date	Pamp	Notes
796.	294.			5	Small Loop .015 Paper pressed to .007 — a small crack in one in side globe and could not get it Even
797.	238.	183	mar 5	5	Small Loop .015 Paper pressed to .007 —
798.	257	200	mch 4	6	Small Loop 18 tissue cut and pressed together —
799.	212	170	mch 4	6	Small Loop 12 tissue cut to getter — after burning — layers of paper [illegible] calculated [illegible] after burning or uncharred [illegible]
800.	235	195	mch 4	5	Large Loop 24 tissue pressed and cut to getter —

No of Lamp.	Before Heating	After Heating	Date	Pump	Notes
801.	275	178	mch 5	5	Large Loop of 18 Tissue cut and pressed together.
802.	260	176	mch 5	4	Large Loop of 24 Tissue Cut and pressed together.
803.	232	189	mch 5	4	Large Loop Same as 802
804.	12½				5 Sheets Linen paper covered on both sides with plumbago & sugar & pressed. — 1 Very high - Spot burnt out - high vacuum
805.	224		mch 6	4	Use Clamps for anneal during Use Carbon Rings Vacuum smoke Reduced copper Reduced on Paper pressed to 007

No of Jumps.	Before Hearing	After Hearing	Date	Pumk.	Notes.
806					Small Loop — copper plated 015 — Paper. pressed to 007 Broken in shoulder
807.	304	mech	6	6	Small Loop. Copper plated 015 — paper. pressed to 007
808.	8000 to 900	mech	7	6	Small crack on the inside globe could not see a Volume one fiber of flax with Copper ends
809.	150		7	6	2 Small Loops — 015 — mech. paper pressed to 007 — Copper ends
810.	309		7	6	Same as above



No of Lamps	Before Heating	After Heating	Date Purple	Notes
811.	500	7	5	Minimilla Fiber Ends copper plated Carbon Exp. 122
812.	449	7	5	Minimilla Fiber ends copper plated Carbon Exp 122
813.	217	190	8 mch 4	Small Loops .015 Uncal. paper pressed to .007 ends copper plated Bad spot at Center Bamboo Small Loop .015 uncal paper Pressed to .007 ends copper plated
814.	222 165	8	5	
815.	199	156	8 mch 4	Small Loops .015 Uncal. paper pressed to .007 ends copper plated Bad spot on side

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No of Lamp.	Before Heating	After Heating	Date Pump.	Notes.
816.	2.85		mch 8 6	Cute Tiles- 8 number Coffered
				Bad connection at clamp. Fiber dirded into- 1/2 the strands at clamp & Built at clamp 3 months Testing
817.	95	87	mch 8 6	Four Tiles- Coated with Plumbago and sugar Coffered.
818.	2000		mch 8 4	manilla fiber- offered One formed at the clamp
819.	2300		mch 8 4	manilla fiber offered to had bad spots in the Carbon and gave a very poor light and the Carbon Ruptured after burning about five hours
820.	345		mch 8 6	~~Lamp Offered~~ Tissue Tiles- 12 in number- Coffered with thin Plumbago and sugar solution- Lamp Stuck to Socket by Thick Plumbago the formed at the clamp

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No of Lamps	Before Reading	After Reading	Date	Pump	Notes
821.	265		mch 8		Carbon fiber. Not well [illegible] Carbon-stuck together by Weighting them in the mould and drawn through the forceps.
822.	252		mch 8	5	Fine fiber stuck together by Weighting them in the mould and drawn through the forceps. It burned out after pump with a high Vacuum. TAE
823.	330.		mch 9	5	Fibre from Palmetto Leaf Carb, 133. Are formed at 1 lamp and Broke the Carbon with a high Vacuum
824.	225				Fibre from Palmetto Leaf. Carb-133. Not inside globe burned out on the pump with high Vacuum
825.	243.	198			Palmetto Leaf Carb - 133 -

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No of Tramp.	Before Heating	After Heating	Date	Pump.	Notes
826.	222	98			Wire grace - Cant 127 - -copper-plated - very brittle
827.	122	87	mch 9	5	Small loops - 015 Paper soaked in Sulphate of Ammonia pressed to .007 - copperd -
828.	144	87	mch 9	5	Small loops .015 - Paper soaked in Sulphate of Ammonia pressed to .007 - copperd -
829.	146	85	mch 9	5 6	Small loops .015 - paper soaked in Sulphate of Ammonia and pressed - copperd -
830.	112	83			Small loops - .015 - paper soaked in Sulphate of Ammonia and pressed to .007 - copperd -

No of Damp.	Before Heating	After Heating	Date Pump.	Notes
831.	142	84		Small Loop .015 paper soaked in Silphate of Ammonia pressed to .007 — Coppered —
832.	137	81		Small Loop .015 paper soaked in Silphate Ammonia pressed to .007 — Coppered —
833	313			Palmetto Leaf Fibre — Coppered — Cotton loosened in clamp & formed arc after it slipped through the clamp — ao
834.	998		much 9 p	Manilla Fibre .007 — Coppered —
835	510		9. 7.	Manilla fibre. about .007 coppered

No of Lamp.	Bgge Heating	After Heating	Date	Pump.	Notes
836.	525		Sept. 7.	7.	Manilla fibre, about .007 Coppered.
837.	397.				Manilla Fibre about .007 = Coppered Carbon burnt off after heating gradually for some time with good Vacuum
838.	397.				Manilla fibre about .007 = Coppered Carbon burnt off same as previous Nos —
839.	123	83	mch. 9	4	Small Loop uncal. 015 Fiber soaked in Sulphate aemonia and pressed to .007 Coppered
840.	146	88	mch. 9	4	Small Loop uncal. 015 Fiber soaked in Sulphate aemonia and pressed to .007 Coppered

No of Lamp.	Before Heating.	After Heating.	Date Pumped.		Notes.
841.	600		mch. 9	6	Manilla fiber. .037 Filed, sealed with platinum. Annealed it clamp and broke the carbon
842.					
843.	51.		mch. 9.	6.	Palmetto leaf. Coppered.
844.	36			7	Palmetto Leaf Coppered. Burned on the pump with a good vacuum the clamp got red hot and broke the lamp
845.	306.		9.	6.	Two threads sealed off with high vacuum too high resistance to even flash glow.

No of Lamp-	Before Heating	After Heating	Date	Pump	- Notes -
846.	85	80 about	mch 9	5	Wire grass from Florida Coppered Sealed Off and given to Mr. A.E. Stimulett — sold, vacuum broken at the Atmosphere
847.	94		mch 9	5	Wire grass from Florida Coppered
848.	219	184	mch 11	7	Palmetto Leaf. — Coppered —
849.	219			7	Palmetto Leaf. — Coppered — Carbon broken at clamps taken out to put in a new bulb,
850.	224				Small Loop soaked in starch and H2O and pressed — carb 10H —

No. of Transp.	Begone Heating	After Heating	Date	Pump.	Notes.
851	230				Small Loop soaked in starch and H_2O and pressed - cook, 154
852	225				Small Loop soaked in starch and H_2O and pressed - cook 154 Bud Sylvester other Conductor
853	221				Small Loop soaked in starch and H_2O and pressed - cook 154
854	60				Palmetto Leaf. - Coppered. - Broke the same as 855
855	54				Palmetto Leaf. - Coppered. - Strands were disintegrated when put on pumps and at first testing separated - poor test -

206

207

No of Lamp.	Before Heating	After Heating	Date.	Pump.	Notes.
856.	63.	50			Palmetto Leaf, - Coppered - Same as previous no - very poor fibre. - Noticed the break was just above the copper plating -
857.					Small Loop .015 Soaked in Sulphate of Ammonia & dried Broken at Glassblowers while putting in stock
858.	136		mch 11	4	Small Loops
859.	117	84	mch 11	4	Small Loops
860.	250				Small Loop .015 Soaked in Sulphate of Ammonia and pressed Carbon broke just before starting up. Very good vac. High Platinum Carbon

208

No. of Inoculation.	Before Healing	After Healing	Date	Pump	Notes
861.	221, 83				Small Loop .015 soaked in Sulphate of Ammonia and pressed.
862.					Small Loop .015 soaked in Sulphate of Ammonia + pressed.
863.	186		mch 15	6	Small Loop of .015 Soaked in Sulphate Ammonia and pressed
864.	209		mch 13	6	Small Loop of .015 Soaked in Sulphate Ammonia and Pressed
865.	181		mch 18	6	Small Loop of .015 Soaked in Sulphate Ammonia and Pressed

No of Damp.	Before Reading	After Reading	Date	Pump	Notes
866.	181		mch 13	mech vacuum pump	Small Loop of ow. Soaked in sulphite Ammonia and Pressed
867.			mch 20.		Bass fibes-Small Copper Plate ends
868.			mch 20.		Bass fiber-Small Copper Plate ends
869.	136	90	mch 13	4	Small Loop of ow. Soaked in Sulphate Ammonia and pressed on pump for about one minute could not get a high vacuum
870.	173	97	mch 13	4	Small Loop of ow. Soaked in Sulphate Ammonia and pressed on the pump for about one minute could not get a high vacuum

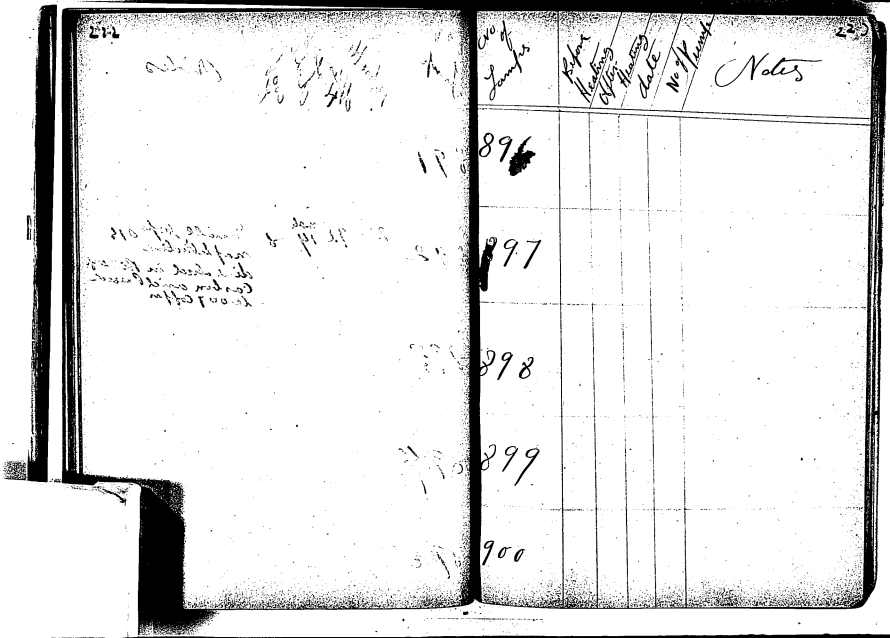
Number of Lamps	Before Heating	After Heating	Date	Pump	Notes
871.					Small Loop soaked in Sulphate of Ammonia & pressed Broken by Glassblower.
872.	286	85	arch cem 13	F	Small Loop of 015 Soaked in Sulphate Ammonia and pressed
873.	155	97	arch cem 13	F	Small Loop of 015 Soaked in Sulphate Ammonia and pressed
874	170	92	arch cem 13	Jump	Small Loop of 015 Soaked in Sulphate Ammonia and Pressed Iw Platinum in the Centre Glass heated red in one minute
875.	195		arch cem 13	Jump	Small Loop of 015 Soaked in Sulphate Ammonia and Pressed

No of Jump	Before Putting Oil in Mixing	Date of Jump	Notes
876	164	mch 13 4	Small Loop of Oil Soaked in Sulphate Ammonia and Pressed
877	178	mch 13 7	Small Loop of Oil Soaked in Sulphate Ammonia and Pressed Sealed by order of Mr Batchelor
878	241	mch 13 mch 13	Small Loop of Oil Soaked in Sulphate Ammonia and Pressed Ball Spot in the center
879	187	mch 13 7	Small Loop of Oil Soaked in Sulphate Ammonia and Pressed Sealed by order from Mr Batchelor
880	177	mch 13 new	Small Loop of Oil Soaked in Sulphate Ammonia and Pressed Ball Spot in the center

Stock Samples	Photographing Negatives	Date	Time	Notes
881	174	1913	4	Small Loop of O14- Soaked in Sulphide Ammonia and Pressed
882	420 242	1914	4	Small Loop O14- Soaked in Aniline oil and Pressed - Bad Spot in the Carbon
883	355 209	1914	4	Small Loop O14- Soaked in Aniline oil and Pressed
884	440 253	1918	4	Small Loop O14- Soaked in Aniline oil and Pressed
885	160 85	1919		Small Loops [illegible]

No of Lamps	Before Heating	After Heating	Date	No of Heats	Notes
886	235	197	mch 14	8	Small Loops 015 unpressed to 007 treated with Hydrofluoric acid and Plated with Copper
887	260	231	mch 14	4	Small Loops of unpressed Pressed to 007 treated with Hydrofluoric acid and Plated with Copper
888	450	287	mch 14	4	Small Loops 015 unpressed Soaked in Tar-dissolved in Kerosene Coppered
889	370		mch 14	6	Small Loops 015 unpressed soaked in Tar-dissolved in Kerosene Coppered the Carbon Broke on the first Heating
890	162		mch 14	6	Small Loops 015 naphthaline dissolve in Bi sulf Carbon and Pressed to 007 Coppered and the Carbon Broke on the first Heating

Coal Tank	Retort Heating	Office Heating	Cook Tank	Notes
891				
892	210	92	mak 14 8	Smells strongly of Naphthaline dissolved in Benzene Carbon and Benzol & coal Tar.
893				
894				
895				


212
No of Samples
Before Heating
After Heating
date
No of Sheets
Notes
896
897
898
899
900

Cno of Book	Before Heating	After Heating	Date	Plants	Notes
901					
902					
903	410	201	Aug 16	4	Small Loops 015- Soaked in Aniline oil and Pressed
904	410	214	Aug 16	4	Small Loops 015 Soaked in Aniline oil and Pressed

No of Lamp.	Before Heating	After Heating	Date - Pump	Notes.
905	360	191	Mar 16	Small Loop. .015 soaked in Anailine Oil and pressed
906	220	176	Mar 16	Small Loop unsaturated paper soaked in resin dissolved in alchohol & pressed.
907	225	213	Mar 16	Small Loop unpressed soaked in Anthracine in Turpentine and pressed 007
908	220		Mar 16	Same as 907- Accidently broken by Dahl

No. of Lamp.	Boiler Heated	Water Heated	Date	Pump	-Notes-
909	150		Mar 16	H	First Pierced Plumbago Small Loop from new mould made by Dean same paper on both sides A Broke at first Heating
910			Mar 16	H	first Pierced Plumbago Small Loop from new mould made by Dean same paper on both sides Broke on the pump
911	500		17		Selected Fibres. Manilla High Resistance. [redacted] made crack on the outside Left and heated off Pump
912	780	500	17	H	Selected Carbonized Fiber Manilla High Res.
913	840	650	17		Selected Fiber. Manilla High Res.

No of Dump	Before Washing / After Washing / Date	Pump	Notes
914	2m 152 mch 17	&	.015 Mbs calendered paper soaked in Nitrin + alcohol & pressed to .007.
915	.99		1 small Fiber Mbs paper coated (2) Black Defiant (N.C.) on both White Leating Under both at clamps after heating some tubes very low resistance.
916	156 111 Mar 17	&	Brass Fiber coated with Plumbago + sugar Cond 161
917	463		Manilla Fiber (Pulped) Cond 162
919	516 544		Manilla Fiber selected, Cond 162

No of Lamps	Before Heating	After Heating	Date	Temp	Makes
918.	1297	750		mch 1-8	Selected Manilla Fiber Carb 162
920.	790	475		1 8	Selected Manilla Fiber Carb 162 very high resistance does not strike brightly
921.	1135	848		mch 18 8	Manilla fiber Carb 162 coppered
922.	1300	848		mch 18 8	Manilla fiber Carb 162 coppered
923	800	570		mch 18 1	Manilla fiber Carb 162 coppered Bad Spot in Carbon

No of Lamp	Before Heating	After Heating	Date	Pump	Notes
924	1300 1290	mon	18	4	Manilla fiber-cart 164 Coppered
925	688 450	mch	18	8	manilla fiber-cart 164 Coppered
926	170	mch	18	8	cocoa nut fiber cart 164 Picked Coppered ends Not formed at the Clamp and Burnee the Carbon
927	125				Selected Cocoanut Fibers – Coppered Ends – – Cart, 164 –
928	440 340				Selected Cocoanut Fibers – Coppered Ends – – Cart – 164 – W. J. Hammer

No of Lamps.	Before Heating	After Heating	Date Pump.	Notes.
929.	182.	115	mch 19	Acetic Acid Sol pressed To 1.007 Small Loop could not get a high Vacuum
930.	199	117	mch 19	Same as 929
931.	72			Wire Grass copper Ends
932.	274			Small Loop Skeleton Solution pressed 1.015 5.00? Copper plated Ends.
933.	322			Platinized Ends

No of Tramp	Before / Making / After Heating	Date	Remk.
934	.010		Same as previous
935	.67	mch 19	Silver plated Ends. Crack found at annealing point. Then came from G. Pfd sealed from stock, put in new tube. Small Loop Molasses Solution 01% Pressed to 007
936	.88 .66	mch 19	Small Loop cast 174 Molasses Solution 01% Pressed to 007
937	.66	mch 19	Small Loop Cast 174 Molasses Solution 01% Pressed to 007. Buckled on the pump the first heating
938	.74	mch 19	Small Loop Cast 174 Molasses Solution 01% Pressed to 007

- Notes -

No of Lamp	Before Hearing	After Hearing	Date	Pump	Notes
939	87		mch 19		Small Loop Cast 174 Molasses Solution Ols: Pressed to 007
940	97		mch 19	4	Small Loop Molasses Solution Ols: Pressed to 007
941	97		mch 19	4	Small Loop Molasses Solution Ols: Pressed to 007
942	74		mch 19	8	Small Loop molasses Solution Ols: Pressed to 007
943	76		mch 20		Small Loop Cast 174 Molasses Solution Ols: Pressed to 007

243

No of Stamp	Before Heating / After Heating	Date — Temp	Notes —
944 63		24	Small Scrap Carb 174 Molasses Solution 01% Pressed to 007 Plan cracked at rims sealed off pump
945 72		24	Small Scrap Carb 174 Molasses Solution 01% Pressed to 007
946 54		24	Small Scrap Carb 174 Molasses Solution 01% Pressed to 007
947 78		24	Small Scrap Carb 174 Molasses Solution 01% Pressed to 007
948 67		24	Small Scrap Carb 174 Molasses Solution 01% Pressed to 007 Broken at Glass Blowers after sealed off all OK

245

No. of Sample	Before Heating	After Heating	Date	No. of Plants	Notes
949	51		mch 19		Small leaf Con. 6/74 molasses Solution .015 Diluted to .007 Drop in the dirt Sick Earth Could not get Plant
950	87	69	mch 20	4	Wire grass Plumbago seeds
951	95	84	mch 20	4	Wire grass Plumbago seeds
952					
953	560	386	mch 21		Cocoa nut fiber Roland Copper Seeds

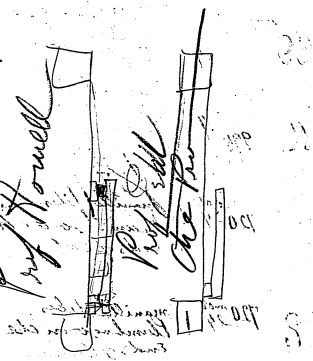
14 9 6 7 0 0 5
2 9 8 3 4 0 1 6 25
5 9 6 6 8 0 3 2 26
1 7 2 3 6 0 6 4 27
2 3 5 4 3 2 1 2 6 28
5 5 7 0 9 4 4 2 4 6 29
1 1 4 1 1 5 5 8 2 1 2 30
2 1 5 3 7 8 6 2 2 4 31

Number of Lamp	Before Heating Filter Weighed	After Heating Plate Pumped		Notes
954	435		mch 21	fiber from the young Palmetto Leaf copper Ends Carbon Broke at the Clamp at first Heating
955	330		mch 21	fiber from the young Palmetto Leaf copper Ends Carbon Broke at the Clamp at the first Heating
956	365		mch 21	fiber from the young Palmetto Leaf Plumbago Ends Broke the carbon at the first Heating
957	111		mch 21	Black moss from florida With Joints in it Copper Plate Ends Broke the Carbon at the first Heating
958	232		mch 22	Black moss from florida With Joints in it copper Plate Ends Broke the Carbon at the first heating

Number of Tamps	Before Reading	After Reading	Date	Pump	Notes
959	650	294	mch 20		Cocoa nut fiber-Picked Bad Spot in the side of Carbon
960	104		mch 21		Cocoa nut fiber Picked Copper ends
961	615	486	mch 21		Cocoa nut fibes-Picked Cord 164 Copper ends
962	458	229	mch 20		Cocoa NOT fiber-Picked
963			mch 21		~~Cocoa nut fiber Picked~~

Number of Jump	Before Heating	Hi Heating	Date Jump	Notes
964				
965	685	mch 21		fibers - from the young Palmetto Leaf Cart 172 Fibers - Plate ends Broke at the first heating
966				
967	87	mch 20		Bass fibers - Small Copper Plate Ends Red Spot on Carbon at Clasp Sealed Tube
968	137 93	mch 20		Bass fibers - Small Copper Plate ends

Equivalent Lamp	Before Heating	After Heating	Added	Date	Hump	Notes
969	~~990~~			~~mch~~ 24	8	~~Blue Lines~~ Broke on the Carbon
970	995			mch 24	8	manilla fibes- Plumbago on the Ends of Carbon
971	720			mch 24	1	manilla fibes- Plumbago on the Ends of Carbon
972	720			mch 24	1	manilla fibes- Plumbago on the Ends of Carbon
973	760			mch 24	4	manilla fibes- Plumbago on Ends of Carbon Arc at the Clamps



77

100 100 10000 100 10000 44 40000 40000 44000000

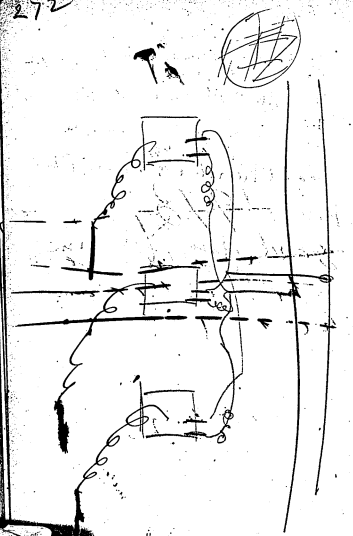
Jarchullers—in the [illegible] good [illegible] hammers—

300) 44000000 (14666

14
12
40
2

3810

272



8.18 270

8.22 a.w.o. no change

8.36 a fall 4 mill current broken off

9. current put on

9.05 18 mill. e Taken off

9.35 current put on. 11 miles from up.

Engine stops. Pump kept on

Jumping

Jumped 45 ft. Burnt over

house and other pole

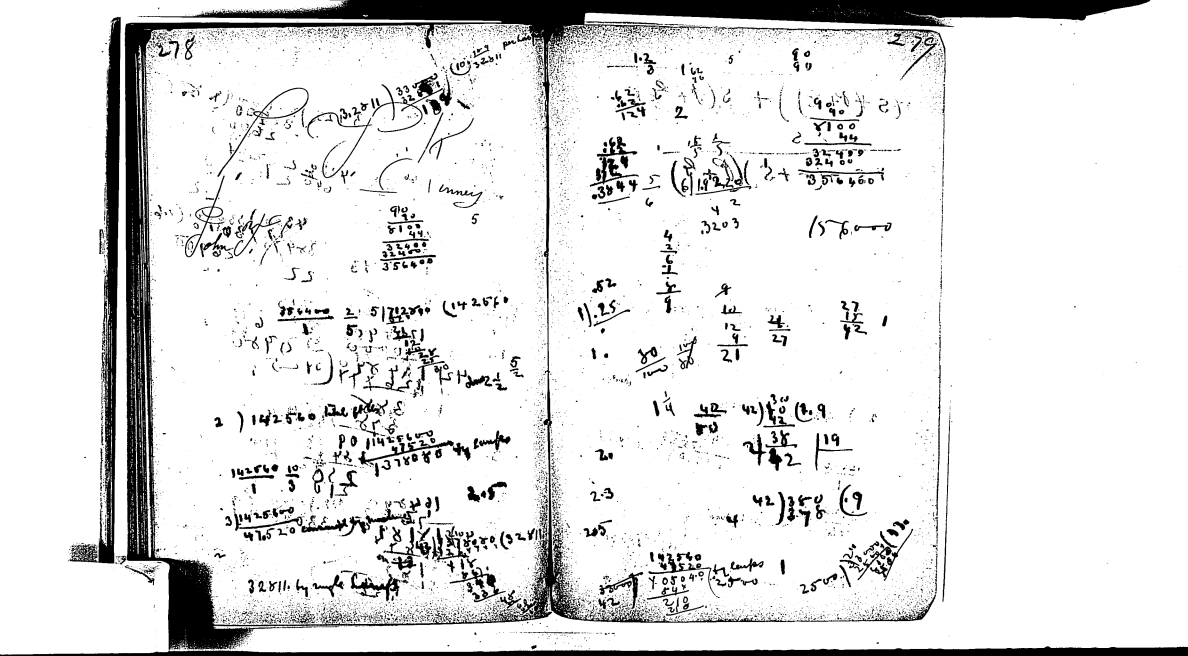
Broke with a fall on

the post

Frances Pohl

Kannapolis City

Elektrotechn Ingenieurbüro



$$\frac{s}{s+(b+d)} \times \frac{3}{s} + \lambda$$

$$\frac{s}{s+(b+d)} \times \frac{s}{3} + \lambda$$

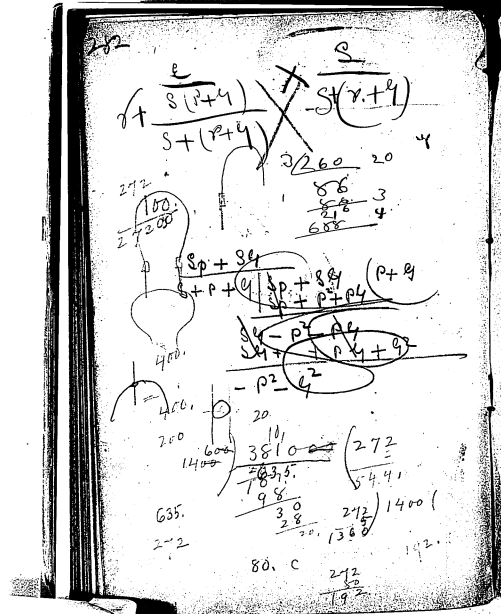
$$\frac{s}{s+(b+d)} \times \frac{2b+ds}{s^2} + \lambda$$

$$\frac{s}{(b+d)+s} \times \frac{2b+ds}{s^2} + \lambda$$

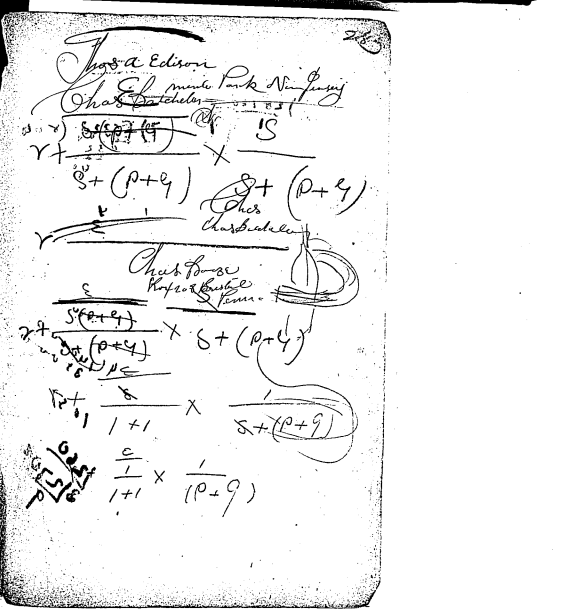
$$\frac{(b+d)+s}{s^2} + \lambda$$

$$\frac{(b+d)+s}{2b+ds} + \lambda$$

$$\frac{(b+d)+s}{(b+d)s



Thos A Edison
Chas Batchelor Menlo Park N. Jersey

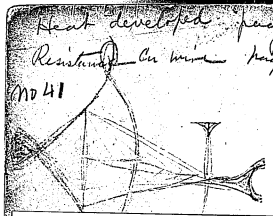


Menlo Park Notebook #41.2 [N-79-10-18]

This notebook covers the period October 1879-February 1880. Most of the entries are by Francis Upton. There are also entries by Edison, Samuel D. Mott, and John Kruesi. All of the material relates to electric light and power experiments. Included are notes, drawings, and calculations about generators; notes and calculations relating to tests of sewing machine motors; notes, drawings, and calculations on electric power distribution; and notes on testing wires. The label on the front cover is marked "Faradic Machines No. 3" and "Upton." The book contains 284 numbered pages.

Blank pages not filmed: 262, 265-275.

Missing page numbers: 167-168, 263-264.



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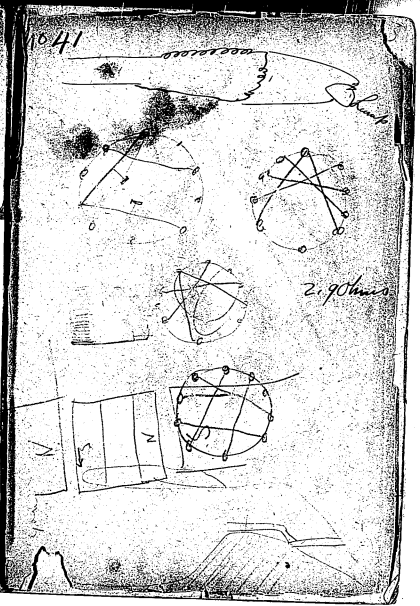
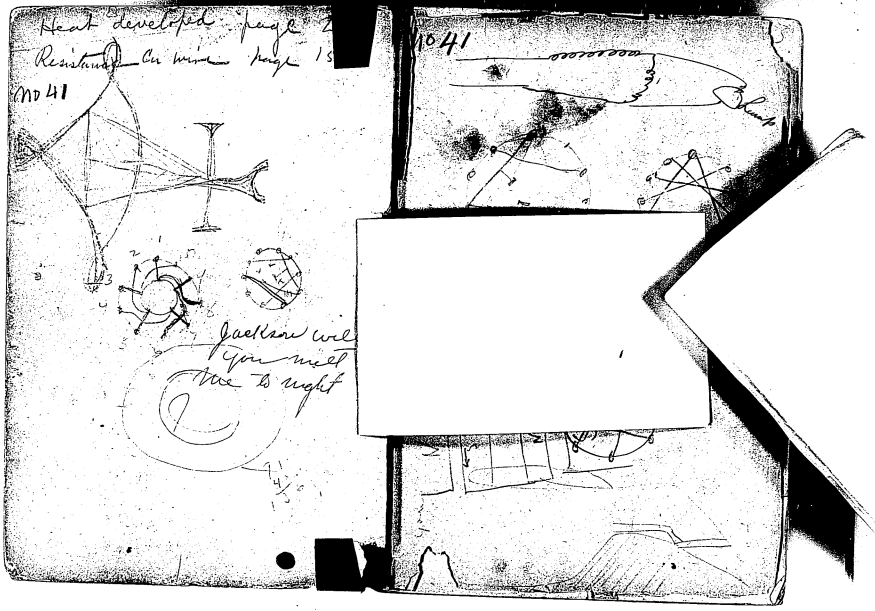



Heat developed
Resistance
MD 41
1041
Jackson will
you meet
me to night

4.75	.6767
conv to 16.	8.7959
450	2.6532
3.14	.4969
	2.6227
2	.3010
	2.9237

838 ft. lbs

Sewing machine motor

450 revs.

Wt 1 foot from axis

$4\frac{3}{4}$ oz

$\frac{4.75}{16}$ lbs

838 ft lbs given off to the Prony when the friction wheel was held still. Probably very poor determination. Yet it shows that only about 1/4 of the power absorbed by the machine is given off.

Resistance of machine

337 : 674 :: 6.08 : X

674

6.08

337

X = 12.08 Ohms

27 - Kilowatt Hour Meter

34 over 6.08 Ohms

29.6 over Machine

Running Machine through leather

3.41

276

.31

.8325
.7839
.0486
.0486
.7839
1.5464
2.5275 337 foot lbs

337
296
comp 34

2.5275
2.47.12
8.4685
3.4673 2930 /

337
2
674

2256 2.3534
2930 3.4669
.8865

33.000 4.5185
3 3534
1.1651
4.5785
3.4669
1.1116 1/13 H.P

Motor giving Current

3.4
2
6.8 Volts

6.8
6.08
1.11 Watts

337 foot lbs. given off from the resistance

34 : 296 :: 337 : X

X = 2930 ft. lbs. consumed on machine

2930
674
2256 in power

75% of power entering machine in work

1/14 H.P work

4.5-185
3.11.95
1.3990

Results

Running free

Total 1317 ft lbs 1/25 H.P

Sewing leather 122. 90.%

Total 2930 ft lbs 1/13 H.P

674

Pulley held fast 75-%

Total 3728 ft lbs 1/9 H.P

1460

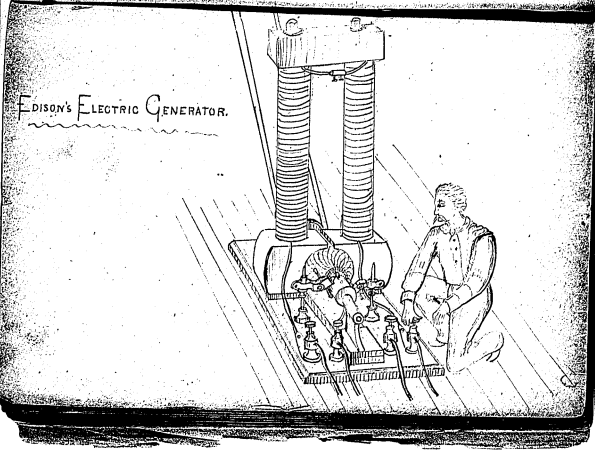
60%

Twenty cells of battery ran the motor slowly.

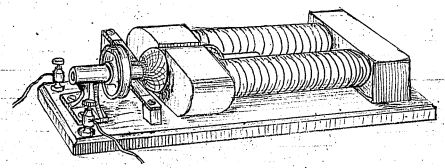
Wanted — A measurement of the power that various sewing machines take to drive.

1000 feet per minute on wheel 4 feet in circumference 250 times per minute

Test for motor Prony to measure power absorbed

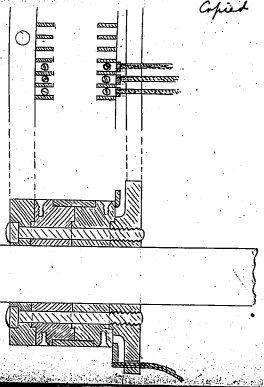


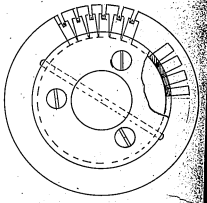
EDISON'S ELECTRIC GENERATOR.



EDISON'S ELECTRIC MOTOR. No. 1

Copied from working drawing





Oct. 18 1879

COMUTATOR

Faraday Motor No. 2

Resistance = 17.9 Ohms
= 17.5 Ohms
same all round Oct. 20, 1879.

Wound with wire = .042 in
on magnet No. 19 6-7
Or armature No. 24 .022
~~11.5 Ohms~~ 11. Ohms

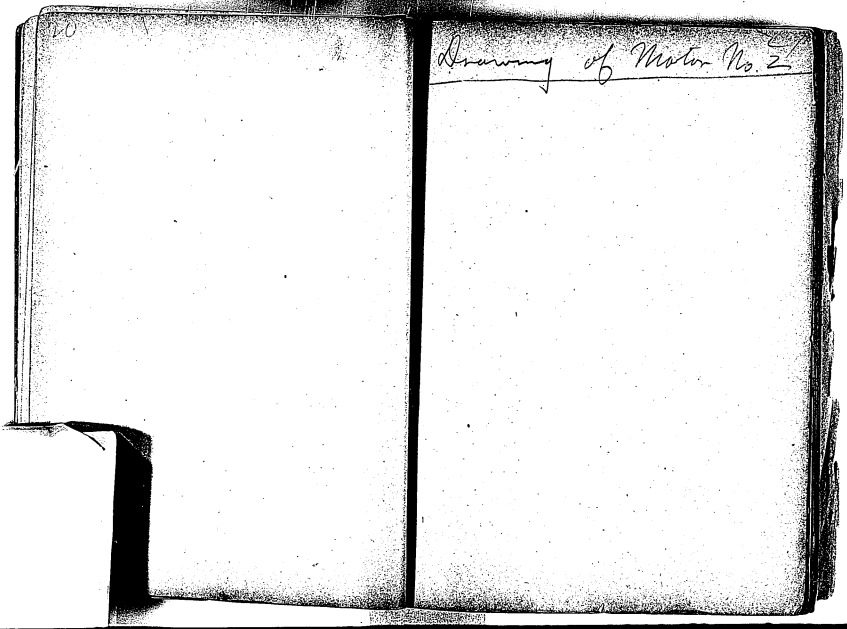
~~27 coils~~ 8 layers
25 coils 6 in coil

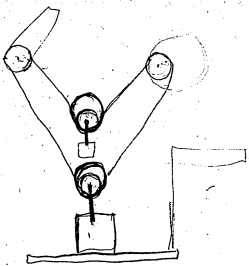
.022 wire
1 covering
.025
8
.200

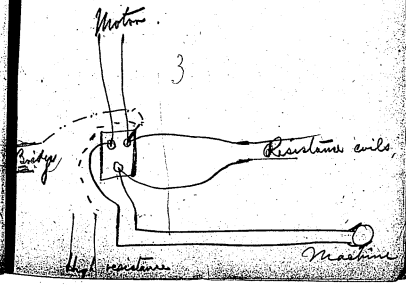
Page 109

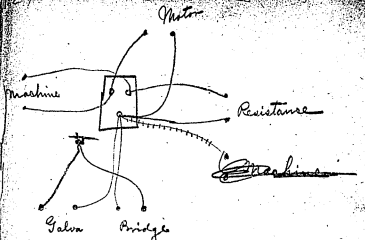
17.9
8.8
9.1

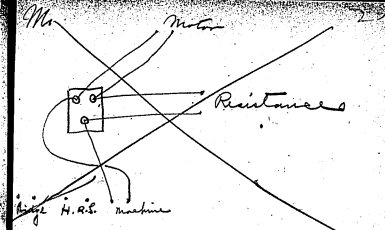
About 9.1 Ohms taking the
resistance at coiled part from

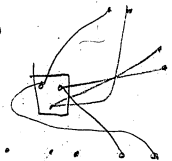

Drawing of Motor No. 2




Motor
3
Pulley
Resistance coils
Machine
Hoisting apparatus


Motor
Machine
Resistance
Galva
Bridge


Motor
Resistance
Bridge
H.R.S.
machine



1.64591
4.5185.1
7.12740

1460 gro

1.1
4.5

Same current through
No 1 & 2 Motors

No 2 1100 revs
No 1 scarcely moving

This seems to be owing to the way of bringing up the magnets

Again No 2 scarcely moving
No. 1 2010

No. 2 Whole current on
400 revs. Dead point tried to remove by having more pressure

Resistance		
13.2	19.6	
16.2	16.7	
17.9	10.6	
19.1	8.8	
19.5	12.4	
19.5		

Wheels on No 1 Rig

2/8.25 inches

.687 feet

Tried a dynamometer with small wheels dead failure too much play in wheels Cross grinding No. 2 Motion Cotton covered wire ordered 20 ans 6 amid cross

20

No. 1 .03.125

No. 9 .21.855

97/32 = 9.218

9.02

.198

8.75

.27

9.02 Between wire & face

1.49

9

1.40

.045

6

.270 Thickness of wire

97/32 in bore for armature

Wood in armature 6 1/4 inches

Iron ring 1 1/4 inches thick

Diameter armature 8 3/4 = 8.75

9.218

8.75

468

Iron core from the armature

Measure Dec 11 page 120

.81 Measure Dec 13

Oct. 27 1879

21

Sandia Machine No. 1

Round iron core

Made

Dimensions in Ohms

Magnet coil .91

Armature 1.13

coil end 1.11 - 1.13

Magnet wound .135 in diam

2480 turns

Two layers 2

480

core 6 in diam

Iron

Armature wire .032 in average

insulation covering .013

Total .045

39 Coils Three wires wound together six layers.

39

12

78

39

468

8.75 9.375
33 9.18
.055 .195
6
.330 Thickness wire 9 3/8 Wire from face
Round wire

21½ inches whole length of back
14 inches centre of cores

Length armature face of magnet 9¼ inches

Armature wire ¼ inch longer

Iron inside 8½ inches long

Wood in armature 6¼ in diam

Iron ring 1¼" thick

Diameter armature 8 3/4 inches

9.375 140 : 110 Very nearly as 6.25 : 4.68
8.75
.625
Distance from face
312
24
9.40 Measure Dec

Lavadie Macarthur No. 2

Made began 1879 Armature finished Sept 1879
with large wire
Running first the coil became loose
and caught on poles tearing the wire
up.
Replaced
Armature new [illegible] about 70
Dimensions &c Magnet 1.4 Diam
Armature .62

Magnet wound .135 in diam
Three layers 2 3 4 turns Layer
Total No. turns 3 7 0 2
2
1404
Diameter end six inches
Length three feet
Back 6 X 7 in

Armature 39 coils
with diameter wire .042 in
covering .073
.055
Six layers two three

34

8.3329 / 4.1664 / 2.0832 / .7198 / 1.3634 — 3.4466

32 / 6.1 — 1.5051 / .7853 / .7198

85.040 / 4.2505 / 2.1252 / 7.970 / 1.3282 — 3.4535

26 / 4.15 — 1.4150 / 0.6180 / .7970

9.30358 / 4.6529 / 1.2041 / 3.4488

8.9980 / 4.4590 / .9956 / 3.4634

3.4585 / .9800 / 3.47 / 35 / 4.2505 / .9800 / 3.2705

29.8 / 3.12 — 1.4748 / 0.4942 / .9800

Tests

5 cells — 108 — 55

X = 12 from calibrate — 216 — 110

17 cells = 1 — 165

Make — 33

5 cells — 3.4450

32 Volts — 6.1 Ohms

Elec Dyne 1° 14' — 3.4466

~~28.3 Volts and 4.15 Ohms~~

Elec Dyne 1° 4 9'

29.8 on 3-12

~~3° 55'~~ 4° 4.5 ? 9.9 Ohms — 3.4683

11° 40' 16 Webers — 3.4485

$\frac{113}{54}$ 2.0531
1.7324
.3207
0.6990
.0334
1.0531

$\frac{10\%}{540}$

11.13
5.4
16.53

My Dear Sadie

Will you meet me to night at the north

Jack Lee

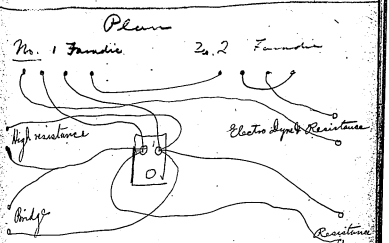
No. 1 Machine 535 revo.

From Magnets 75 Volts
with no any current on field

$\left(\frac{113}{54} + 5\right)$ D amills made to give a deflection of 33

16.53 Volts D = 33
1 Volt D = 2

Plan



4
Resistance 9.1) Webers
4.03
36
340

On field 2758 / 29
5.4 .7324
5.4 .7324
92 7.9638
44.3 1.6468

7.04
29
118

3.0756
945 ft lbs

1.6624
8475
1.6148

4.12 Webers

23
18.5

1.6807
.8475
.2131

1.63

3.5 Volts
12.2 ohms

1.4277

80
7.2) 400 (54
340
288
520

No. 1 Machine

On field No. 1 .43 Do not under-
From Armature 5.5 Volts stand

On field 4.12
From Armature 83. Volt

On field 1.63 Webers
From Armature 59.

From Armature 10 Volts
after the magnet had been left
from the last current

On field .28 Webers
From Armature 13.5 Volts

On Field 1948 ft lbs 5.4 Webers
From Armature 101.5 Volts

Bad Sparks on the top of the
Commutator

46

557
123
74
625
74
1.7959
.8692
.9267

273
118
59
1.7709
.7745
.9964
5.95

.9964
.9964
1.6102
3602.0
4010
4.5185
3.6030
.9155

282
141

111
56.5
1.7443
4.94
6937

1.0506
11.0506
1.6102
3.7114
4.5185
3.7114
.8071

4.5185
3.8402
.6779

1292
146
103
51.5
1.7118
51.5
3.95
.5966

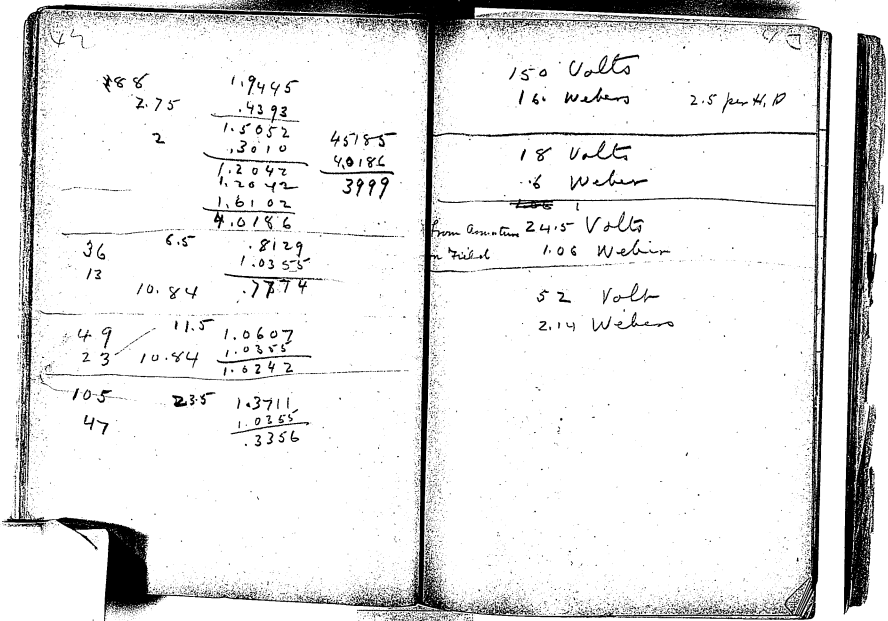
1.1152
1.1152
1.6102
3.8406
3.8406

525 revolutions
Armature 128 Volts
On Field 8.44 Webers

From Armature 136 Volts
On Field 9.9 Webers
4010 ft. lbs. in magnet
8.2 per H.P.

From Armature 141 Volts
11.2 Webers
6.4 per H.P.

146 Volts
13 Webers
4.7 per H.P.



#88
2.75
1.9445
.4393
1.5052
2
.3010
1.2042
1.2042
1.6102
4.0186
45785
4.0186
3999

36
13
6.5
10.84
.8129
1.0355
.7774

49
23
11.5
10.84
1.0607
1.0355
1.0252

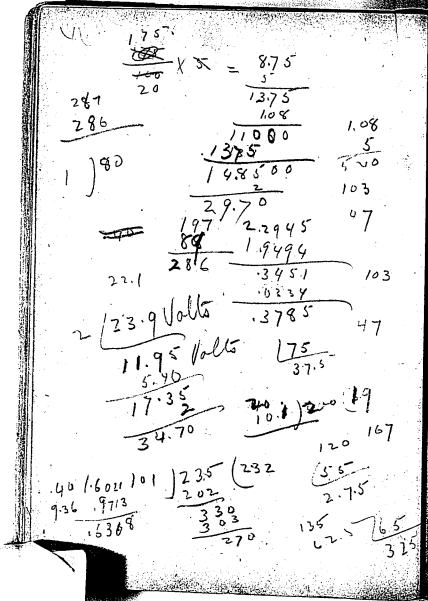
10.5
47
23.5
1.3711
1.0355
.3356

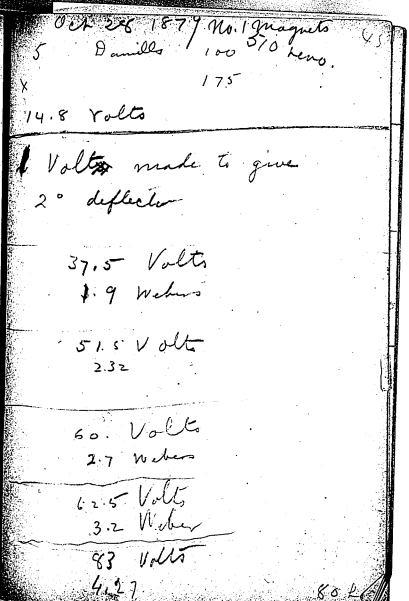
150 Volts
1.6 Webers
2.5 per H, D

18 Volts
.6 Webers

From Commutation 24.5 Volts
Field 1.06 Webers

52 Volts
2.14 Webers




Oct 28 1877 No. 1 magnets
5 Bunsells 100 570 Leno.
175
14.8 Volts
1 Volt made to give
2° deflection
37.5 Volts
1.9 Webers
51.5 Volts
2.32
60. Volts
2.7 Webers
62.5 Volts
3.2 Webers
83 Volts
4.27

90
45 1.6532
.9713
.6819

57.5 1.7597
.9713
.7884

51.5 1.7118
.9713
.7405

115

57.5 1.7597
7.54 .8774
1 .8823

57 1.7559
6.7 .8261
.9298

56 1.7482
5.04 .7024
1.0458

53 1.7243
4.74 .6756
1.0487

90 Volts
4.8 Webers

98 Volts
5.5 Webers
On Toilet

106 Volts .5
6.14 Webers 1

127 Volts
17.62 Webers

125 Volts
8.5 Webers
126 Volts
8.5 2

133 Volts
10

137 Volts

111

150
90

51 1.7076
3.48 .4886
1.2190
1.2190
1.4102
4.1482

4.5185
4.1452
.3703

201. 2.3032
86.5 1.9420
0.3662
.0334
.3996

23
5

105
23
324
216
24.84

.6990
.0334
.7324

25 Volts

2125
1205
5.4
17.9

267 133 No. 1 Machine
134 magnets
5.64

290 145 Volts 23 Per N.A
102 16.5 Watts 30 Ohms

10

51 1.7076
3.6 .5563
1.1513
1.1513
1.6102
3.9128

4.5185
3.9128
.6057

51 1.7076
3.84 .5843
1.1233
1.1233
1.6102
3.8568

4.5185
3.8568
.6617

54 1.7324
14.5 2900
1.4424
1.13 .0531
1.4955

24/104
26

3 15

13.3
7
93.1 Volts

14.1 Webers
4. Magnets per H.P.

13.3 Webers
4.6 Magnets per H.P.

54 Volts
2.77 Webers
138 Volts

13.3 1.1239
1.1239

4.78 13.3

99

837
867

3333 Ohms
39 Ohms

96 / 3.80 = 25.248

25.248 × 3.8 = 95.9424

95.9424 + 0.5798 = 96.5222

96.5222 + 1.1014 = 97.6236

97.6236 + 1.1014 = 98.7250

12.6

273 / 136.5 = 2

39

2.1335
1.5911
.5424
.6034
1.1458

270
293
264
26
132 Volts
6.6

270 / 1.35 = 200

135 2.1305
293 1.4669
1.1 .6636
304 1.4771
2.1241

2.1305
1.4669
.6636
258 1.4771
2.1407

No. 1, Machine
Page 31

12.6 Webers on magnet

3.4 Webers in the armature, 140 Volts — 136.5 Volts, 39 Ohms

4.4 Webers in the armature, 138 Volts — 135 Volts and 29 Ohms

6.6 Webers in the armature, 140 Volts — 132 Volts and 20 Ohms

8.9 Webers in the armature, 137 Volts — 128 Volts or 14.3 Ohms

9.8 Webers in the armature, 135 Volts — 126 Volts or 12.8 Ohms

~~11.8~~ Webers 134 Volts	122 Volts 10.7 Ohms
12 Webers 130 Volts	120 Volts 9.7 Ohms
13.8 Webers 134 Volts	119 Volts 8.6 Ohms
15.3 Webers 135 Volts	117 Volts 7.6
141 Volts extremities	$R = \infty$ 112

17,800 ft. lbs. were given off from the armature of No. 21 machine for ten minutes during stripping test about that of melting casting wax.

J7

I^2R 5.0 35.1

~~2.44 ohms 9.3 Ohms~~

105 Volts on 9.3 ohms

Constant E.D. $\bar{2}.4450$

	9.6989	
	1.8994	
	$\bar{2}.4450$	
25 Webers	1.4044	
.5	1.4044	77 ~~82~~
	$\bar{1}.6990$	7924
	1.6464	6980
	4.1546	.0934

14.2 .0934

4.2486

17,700

Page 73

6. layer two three

Two layer

two three

66

10 10 12 Each.

44 400

4/176 00.

4400

144

44

576

100 4400 6

40/4400 (110 2/6336.

40 40. 3168.

00

1 1/10.

10 per hp

1 Calland . 2 ohm

2 ohm Bounder .

22 foot lbs in Ballu

3/44. 22.

1 Carbon . 2/10 ohm

2 ohm sounder .

78 foot lbs .

44

4

3/176.

77

10 - carland 20 ohm

20 ohm sounder 55 foot lbs total

1 4/10

10 Carbon 2 -

20 ohm sounder

500 ft lbs.

100

40/4400 (

110.

55.

20

400.

11

40

440

22

500

176

110

40

4400

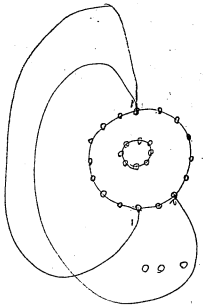
44

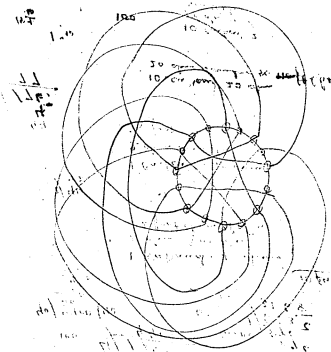
400

22/17600 (

176

15.





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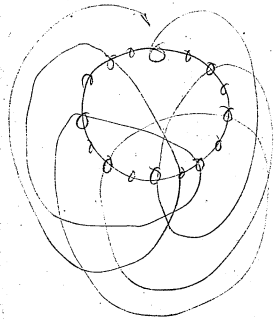

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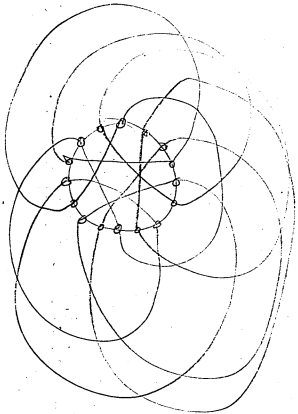
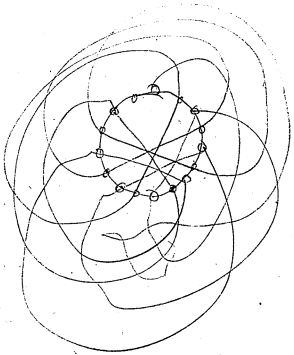
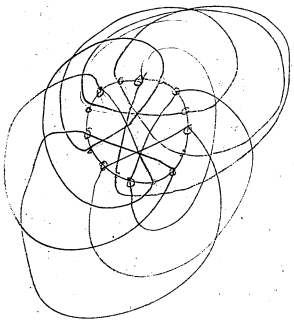
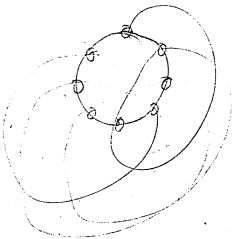
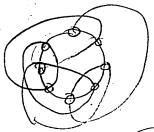
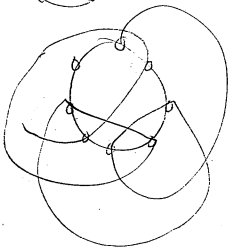


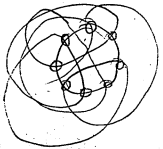


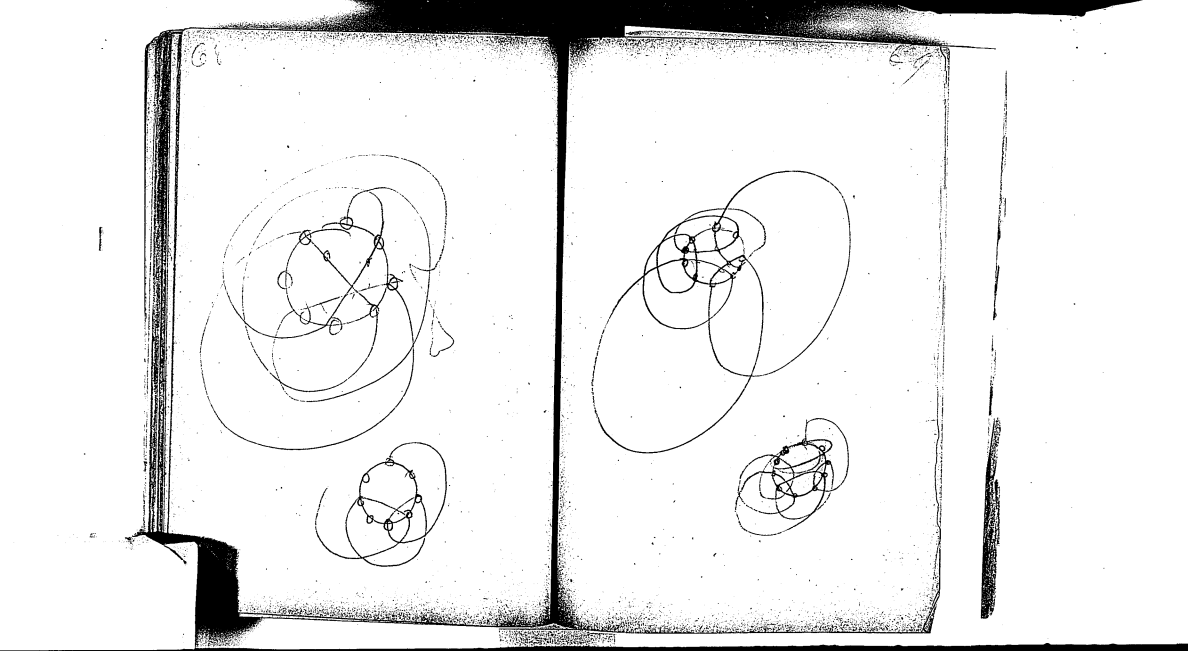


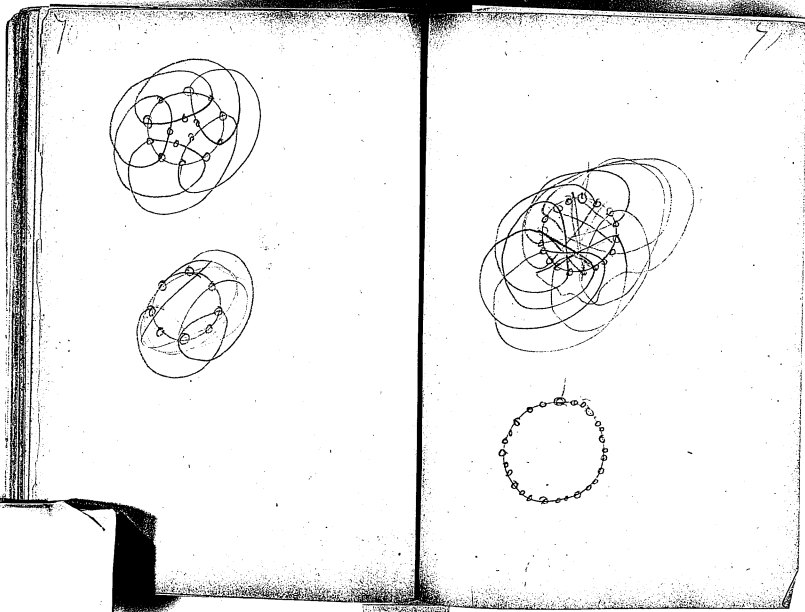


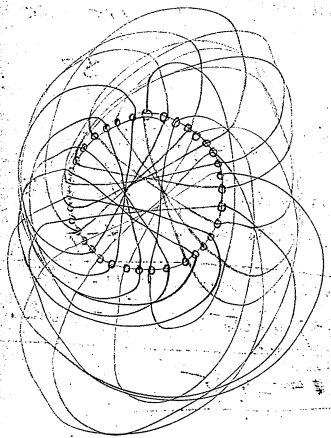












140 Volts from Armature

No. 1. Machine

115 Volts

armd

8.7

7.18 armt

Oct. 30

142 Volts from Armature

R = 80.000 Ohms

13.3 Webers

116 Volts

armd

130 Volts from armature

8-7

14.3 Webers

Ld. 2 Volts

armd

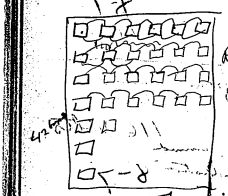
127 Volts

7.8 Ohms

Ford charged

498 revs

142 Volts



Method pursued

The resistance is placed in the direct circuit from the armature. The extremities of the galvanometer placed at the binding posts of the machine. The galvanometer used so that 2 deflections represented a Volt. The deflection then had only to be divided by two to obtain the number of Volts active outside.

108 2.0334
6.9 1.7709
1.2625
.8451
2.1076 128 Volts
102 2.0086 2.1836
5.1 1.7076
1.3 1.3010 200
6.4 .8062
2.1072

16 Webers 112
130 Volts 7 Ohms

106
5.7 Ohms

Made a ground at Galvan to make the Electrometer effect ~~on~~ the same for battery and Machine

~~145 Volts~~ 60.000 Ohms
111 Volts

143 Volts
18.6 Webers 108 Volts
130 Volts 5.9 Ohms
20. Webers 102 Volts
128 Volts 5.1

498 revs

22 Webers

125 Volts

3.8 Horse Power in the last case absorbed by the circuit

On magnet 13.3 Webers

6390 ft lbs

5.1 per H.P.

Dynamometer

127,000 ft. lbs. in circuit

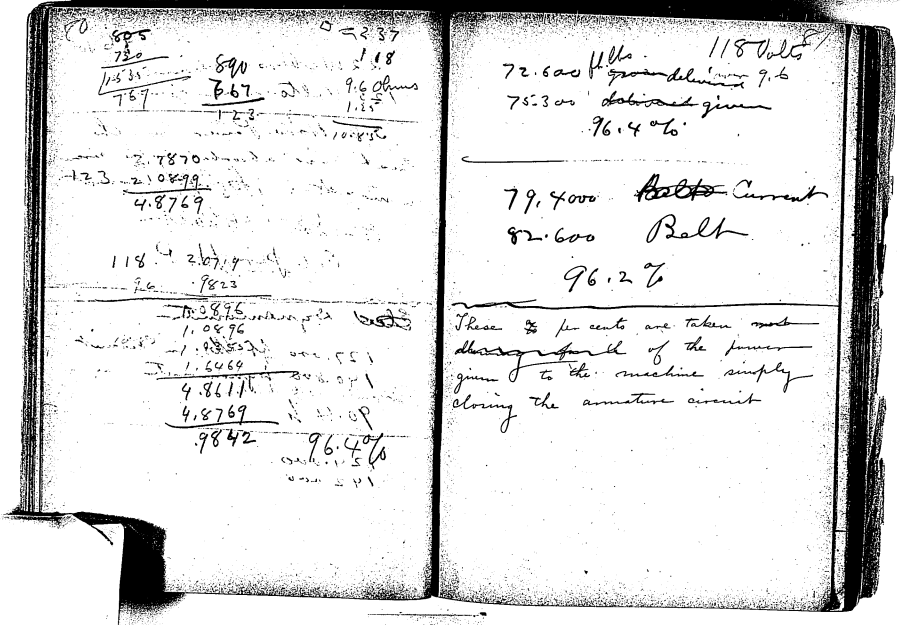
140.800 Dynamometer excluding magnetic pull pulley

90.4 lbs

124.000

142,000

89 lbs



2 | 9.14638
4.5919
3.4450
1.1469
1.1467
1.1464
.1553
4.0955
4.5185
.4230

| 9.3775
4.6887
3.4450
1.2437
1.2437
1.1646
.1553
4.2891

4.5885
4.2891
.2994

12.490

2° 6' | 8.5708
4.2854
3.4450
.8404
.8404
1.8617
3.4825
4.5185
1.0360 10.8

No. 2 Machine

505 turns ε 4.5185
3.6717
.9468
105 Volts

2° 35' | 8.7601
43
3° 18' | 4.3800
2.4450
.9350 8.62 Webers
143 .1553
1.6662
3.6717

8.8 per H.P.

4700 ft. lbs.

14 Webers
115 Volts

8° 4' 12,490 ft. lbs.
43
8° 47 2.64 per H.P.

118 Volts

8° 57'
43
9° 40

116 Volts

13° 5' 17 Webers
13° 4' 1.7 per H.P.

118 Volts

1.9 Webers
0.8 per H.P.

1° 25'
43
2° 8'

100 Volts

52

1.4850

9.4 .9731

.4419

.4419

1.4 .1461

1.6464

2.6763 4 | 4744

4.5915 118 ft. lbs

V6

6

14.4 .9031

1.1584

1.7447

1.7447 685

5 77

25

32 1.5051

9.4 .9731

.5320

Oct. 30

15

96 Volts

43' to be added soon.

Oct. 31 1140 Volts

60° Rad.

1.8 Webers 69 Volts

.56 Webers 26 Volts

2.11 Volts

3.4 Webers 77 Volts

49 1.6902
2(95 9.4 9731
49 .7171

50 1.6990
2(100 .9731
50 .7159

104 1.7160
52 .9731
.7429

191

2(128 1.8062
64 .9494
89 .8568

8.5939
4.2969
.8568
.4401

.8568
.8568
14 .1461
1.6969.1925
3.5061
32004 5.785
1:0124

5.2 Webers
93 Volts

5.2 Webers
92 Volts

20 turns.

5.5 Webers
95 Volts

2° 15'
7.2 Webers
10.3 per H.P.
102 Volts

(9.1772
4.5886
3.4450
1.1436 13.9
1.1436
1.7925
4.0797 12000
4.5315
.4518

3° 41'
8.8078
.4039
3.4450
.9589
.9589
1.7925
3.7103
4.5315
.8212

102.5
4
4.08 .6107
25.65 1.4090
2.0177

100 2
15 1.1761
.8239
15.71.1.9239
1.0198

2.8 per H. P.
8° 39' 13.9 Webers 120 Volts

118 Volts
around

115
around

Polarization
6.6 per H. P 71 Volts
9.1 Webers

3° 5' 107 Volts

4.08 Webers in circuit 102.5 Volts
104 Volts around 25 ohms

6.6 Webers in circuit 100
104 Volts around 15 ohms

96

98 1.9912
94 .9713
1.0199
1.0043
10.1 2.0242

95 1.9777
8.6 .9345
1.0432

10.4 Webers
106 Volts 98 Volts
amps 9.4

105 Volts ÷ 11.0 ohms = 95 Volts
11.0 Webers
8.6 Ohms

105 Volts ÷ 12.160 ohms = 93

92

875
9.3
7788
894

830
780
16.10.
805

894
80.5
89 Mh

3° 47' . or 7 Mh.

481

8.8194
4.4097
1.4450
.9647
.9647
1.7927
3.7199
4.5185
.7986

90.5 1.9566 90.5
7.3 .8633
4.75 1.0933
1.0933
8.05 0.9058
1.6464
4.7388

89 1.9494
2.7905
4.7399

91.0
1.10 2.0414
2.1905
48319

95 1.9777
2.7905
47882

9.2 Webers over Magnet
6.3 per H. P.
12.4 Webers

102 Volts
over 90.5
7.3

There may be trouble noticed a change in measuring resistance

4.7388 54.800
4.7399 54.950
.9989 99.7 %

Exclusive all friction

4.7388
.7582
.9706 93.4 %

Exclusive friction in bearings

4.7388
4.8319
.9079 80.0 %

94

5-20 755 105

105 2.0212
755 2.8779
amp 520 7.2840 10
2.1837 152 Volts

2 18.77.94 137 2.1367
4.3897 73 8633
3.4550
9447
9447
1.7926
3.6819
4.5185
8366

10 lbs to drive No. 2 Machine

3-7905

6170 Ft. lbs to drive the armature at 5-20 revs

No. 2 755 revs

3°27'

8.8 Webers on magnet

6.8 for H.P.

160 Volts
R=6 ohms
137 Volts on 7.3 ohms
130 Volts
over 5.7 ohms

145
117
over 5.7

680
732
1412
706

184 rem.

200 = Δ
100 volts

845
890
1735
867.5

246 = Δ
123 volts

200

867.5
867.5
1665 lbs
1615

57 ohms

h-drive 184
rem

865
920
1785
892

3' to mph
1° 15' on field

164 = 2.2148
2.7905
5.0053

101.000

123	2.0899	2
5.7	.9559	7559
	1.3340	1.2441
	1.3340	1.2441
	.8062	.8062
	1.6464	1.6464
	5.1266	4.9418
	5.0053	5.0053
	3	9365

86.4%

700
100
10000
7144,000
33) 221500 (7

100 830 725 1200

900

1730

865 running in magnet

3.46

1.73 Volts

7° 43' on field

260

130 Volts

535 547

595 595

1130 1142

565 571

No 2 Machine 725 rpm

300 2.4771

2.7905

5.2676

185.000 for the given the machine by the belt

130 2.1139

5.7 0.7559

1.3580

1.3580

6.4 .8062

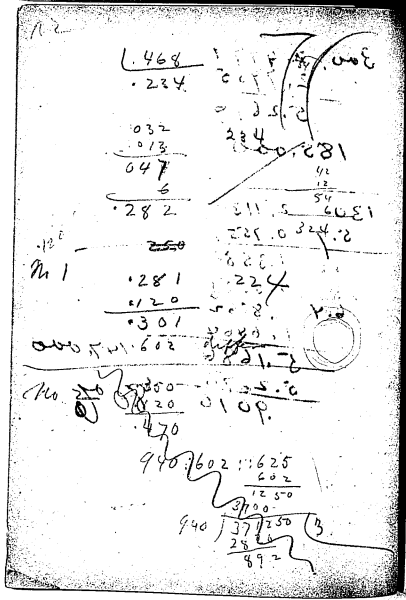
1.6464 In the armature

5.1686 147.000 Ft

5.2676

.9010 80%

Very bad spark at the commutator bars.



Machines Nos. 1 and 2 are wound with the same number of turns of wire. 468 in all. The wire in Machine No. 1 was .032 inch in diameter that of machine No. 2 .042 inch. There was a distance of [illegible] the core of No. 1 to the armature face of the magnet of 468 the same [illegible] No. 2 was .6225. It was [illegible] when eight Volts were on the magnet of No. 2 the E. M. F. of armature was 104 Volts while it No. 1 it was 148 Volts.

If the proportion be made

Distance Coil in No. 1 from armature : " " " No 2 " " :: E. M. F. No. 1 : E. M. F. No. 2

it will be found to be nearly exact from the strength of magnets meaning saturation

Dec 11 1903 - 105

All this is wrong the measurements which Mr. K. gave me were not right

.940 No. 2 machine
.602 No. 1 machine
Of as squares

940 : 602 :: 122 : 78.1

.7796 .7796 .8788
.0880 .0432 .0884
.0264 .0132 .0264
.8940 .8360 .9936
19731 .4865 .4865

.3898
.0864
.5135
.9897

Gas engine unit
97.4 Volts

Also large 3.0 where measure is .81 No. 2

For example

625 : 468 :: 140 : 106

106 instead of 104

6 Webers No. 2. 9 Webers No. 1
97 Volts 128 Volts the ratio

No. 1. 8 Webers No. 2 5.33 Webers
122 Volts 92 Volts in place 93

No. 1. 7 Webers No. 2, 4.67 Webers
114 Volts 86.4 Volts in place 70

No. 1 5 Webers No. 2 3.33 Webers
92 69.7 in place 81

These show that there is general ratio determined by the ratio of the distance of the iron armature from the face of armature field turns!

Nov. 5, 1879 107

It is proposed to wind the No. 1 Machines with one layer of No. 20 wire .035 in diameter

75 commutators Mr. Harris order book Page 186 full section Lamp Order 180

.125
.0625
.03125
5
156

.03125
21
3125
6250
.1676

3.67
3.17
.500

.033

3.17
3.141

.250
.231
.019

25 coils
2
54

Comp 54

3.141
3.7
21981
31.41
99 33
97.97
54
43 97
236

44

around core

1 5/16 5.0 4.16
1.416

033) 184 (7
231

033) 184 (6
198

50) 9.96
1.99
1.65
.34

184
165
.019

48
31

Motor No. 2 Page 19

Drum core 3 in 5/32 a 3.17
Brakes
Four 5 Face 3 21/32 3.67

16/32 1/2 11/32

1/4 inch between

.250

.500 Between diameter core and bore of magnets.

1.416 feet once around

3.
4248
27
8

42.4
25
2120
848
1060 feet 22.6 Ohms

Machine 5.6 Ohms

.1887
44
13.96
7548

110 Motor No. 1

Bore in magnets 3.5 inches

Core 3.15

.350

25 commutators

6 layers
4 side by side
24 Wires in coil

35 : 5 = 0
7 : 1 :: 24 : x
7)240(33.
21
20

Nov. 9 Motor ran too fast with 80 Daniells 4 layers more on magnet.

111

~~Aug.~~ Nov. 19

Tried condensers on the commutator of the machine connecting one side to the brush the other block above it. No Effect

Tried a Battery in place of condenser. Was good. The spark could be taken through the battery but there was no gain in doing so.

The neutral point can be found by taking a piece of wire and rubbing it on the commutator until neither end has a spark between it and half way between these points will be the case. Clean the commutator first.

Dec 8 Faradic Machine No. 3, wound with layer of .035 wire. Resistance .16 Ohm 75 commutator Hook Total difference between iron of core and the face of magnets .160 inch. At 750 revolutions with the magnet of such strength that machine No. 2 gave 120 Volts this machine gave 43 Volts where 116 were expected making it a total failure.

The faces of the magnets were apparently very weak as the iron of the armature was brought so near to them as to satisfy the laws of magnetism.

The ~~plate~~ ~~covered~~ ~~con~~ neutral point was found a little below the line drawn at right angles to magnets. This shows that the discharging time of a magnet depends on the amount of wire wound around it.

The magnet were wound with three layer 1.7 ohms resistance

If this machine had succeeded it would have been the grandest success known, as it is, it is only the same as the other machines. It would be useful for supplying a number of small arcs in multiple arc ~~or~~ or for plating or for running magnets though nothing to boast of.

114

Ohms 2.22
2.11
2.11 Ohms

120 Volts lower

76° 16'
42 44
3° 32'

1.30103
0.32243
9.7767
9.4848 Watts

2 | 8.7897
4.3948
2.4181

87 = D

29.
19° 42' 13.7 Watts
12° 44
6° 58

1.4624
.3203
1.1381

9.0838
4.5419
1.1381
2.4038

Constant Dyne

120 Volts 0 from No. 2 machine almost no current on field

51 Volts

1,1381
1.1281
1.6 .2041
1.6464
4.1267
.5155
8

13300

Each wire 1/4 as strong Total
2. M.F 1/4 X 2/2 as much as
before 1/2 that before

Each layer 1/ .035
12
047
4
.188
32
3 | 152
50

No 3 about .235 between
outside of iron wire and
face of magnet

.047
18
.057
2
114

156
114
42

40
20

I still believe that an 1/8 of
an ohm machine can be
made to give at least 75 Volts.
In order to do this a solid
iron core must be used.
and the wire be flat and
all be made perfectly.

43 43) 110 (2.5
86
240
215
250

.150
.150

.156
25
780
312
3900
.156
.234 = .150 lbs of iron
60 inch of surface
17

No 2 Machine

101 Volts gave 123 Volts
on lamps

20 (8.5428
4.2714
3.4109
.8605 7.25 Watts
.8605
1.6464
.2304
3.6078 4.050
4.5785
.9707 8.1 per H.P.

Measurement of Pin 1.

Thickness of wire .088

Between wire and face +.120

.408

.392

.016

No. 1

Measured the bore 9.42

The wire 8.41

.01

.08

.09

.16

Thickness of wire Bore

No 2 .94 9.40

9.46

.94

No. 3 .17 9.46

9.29

.17

No. 1 122 Volts Range 105.

No. 2

94 : 81 :: 122 : 105 in place of 93

81

122

976

94) 9882 (105 Volts

94

482

470

120

This seems to show that here the strength of the machine decreases faster than the distance of the face of the core from the face of the magnet.

94 : 17 :: 122 : 17

17 | 65 | 38
51
140
136
40

17 | 94 | 85
85
90

125 | 65 | 522
625
250

No. 3 machine space $\frac{1}{5.5}$ that of No. 2

43 Volts in place of 120

43 | 120 | 2.8
86
340
344
215
140

$\frac{1}{28} \times \frac{6}{7.5} =$

6 | 21.00 | 3.5
18

No. 3 $\frac{1}{3.5}$ of E.M.F of No 2

$\frac{1}{3.8}$ of resistance of No. 2

No. 3 Machine

49 × 3 = 147
70
217

49 × 6 = 294
1120
414

120
70
050

No. 3 $\frac{1}{3.5}$ of E.M.F of No. 2

$\frac{1}{6}$ of layers of No. 2

39 × 2 = 78 turns around machine No. 2 (39 wide)

75 Turns around machine No. 3

No. 3 Machine

Now 9.46 face of magnets

.035 × 3 = .105

.047 × 3 = 141

9.46 + .16 = 9.62

Make the bore between the face of magnets 9.62

Make new vulcanite ends a little smaller than the present ones and having an arrangement like that first prepared for No. 3 with so that a steel sheet may be used to keep the coils from

Wind with .035 wire

4 layers | ○○○○ ○○○○ ○○○○ ○○○○ | 4 wires

side by side connected in eights.

1.4 7 33000/20 = 3300

10

7 11/17 (1.4 4700

1.4 33000

2.9 per H.P

N.C.

Maker No. 4

9.62 inches from face of magnets

3/189
63

63

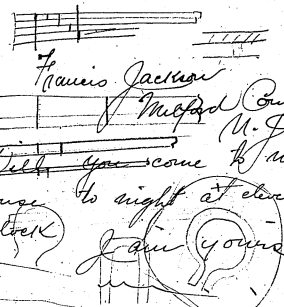
.055
4
.220
4
10
.270
2
.540

1.042
.12
.055

9.62
.54
9.08

.835
.13
.048
3
144

9.46
.144
.604



130

1.4 Ohms

6139.000 ft. Ohms.

5.500 ft. Ohms

55.00 3.7404

1.4 0.1461

2 | 3.5943

1.7971

~~0.27~~ Webers

1.7971

1.4464

.4507

3.5328

1.7971

5.3299

55.00

$\frac{R \times 44.3}{\mathcal{E}^2} = \frac{55.00}{}$

$\mathcal{E}^2 = R \times 443$

$\frac{\mathcal{E}^2 \times 44.3}{R} = 5.500$

$\mathcal{E}^2 = \frac{5500 \times R}{44.3}$

131

$\mathcal{E}^2 R / 44.3 = 5.500$

$\mathcal{E} = \sqrt{\frac{5.500}{R / 44.3}}$

3.5943

1.6464

2 | 1.9479

.9739

9.4 Webers

3.5328

.9739

4.4967

8.9834

3.5328

7.0456

4'

50 39'

~~2.5~~ $C = \sqrt{\sin D}$

$\sin D = c^2$ $\sin D' = c'^2$

$\sin D' = \frac{C'^2}{c^2} \sin D$

10.0000

7.0456

2 | 2.9544

1.4772

30 Webers

Comet

Calculation for wire to hold the Cu. wire to cylinder of armature

Centrifugal force formula

Mallinworth

$F = .00034\ W R M^2$

$W = 1$ lb

$R = \frac{20}{2}$ inches $= \frac{5}{6} = .833$

$M = \frac{600}{6}$ revs $= 3600$

$.00034$
144
1360
1224
1836
3672
$F = 97.6$
101.26

Cu wire .042 inch diameter

Cross section .001385

150 divisions
12
300
150
1800 wires
9 inches long
16200

$.001385$
16200
277000
8310
1385
$22.43\ 7000$ cu inches
$.32$
448
672
7.168 lbs

Covering
1
8.168 lbs
101
816
8.16
824.16

$F = 824$ lbs

Place steel wires every inch 9 on armature

9 | 82.4
91 lbs to bunch wires

10 wires .010 inches

3.14
.000025
1570
628
.00007850
10

.000785 sq inches

Cross section

Tensile strength
2240
52
4480
11200
116480
.000785
583400
931840
821360
92037800

52 tons sq inch

Tensile strength 92 lbs

.14 Ohm

6 wires
4
24
6
144

.14
24
46
28
3.26
6
19.56 Ohms

about 9 lbs of wire

reckoning from resistance

~~but as the wire is smaller~~ for the 1/2 covering the cylinder. Since the wire groups. 9 Ohms in a lb

19.56 | 18 lbs
10
95
76
872
4

.062

1 1/2

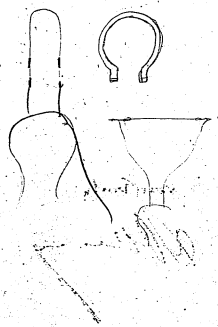
very Truly

15 9 2½

7½ 3⅞

9½

4



Plates 271
Cut 268 10 Ohms out 260
2 Ohms

Sq wire 260
250 after shunts on
other

7 Ohms

The ~~machine~~ armature with
square iron wire wound with
two turns four layers .042 wire
~~100 RPM~~ 86.6 Volts when with a wire
1200 RPM shunt on field magnet the
machine with 1/8" plates gave
90.3 Volts
and round iron armature
92 Volts

52 Volts on 7.2 Ohm 185
Mark 7 ohms at regulator
7.2 Webers on field

7.22 | 52.00 | 7.2
50 84
1460

7.2
7.2
144
504
51.84
446
15552
20736
.20736
2306.51.2
1.4 final 1.6
13839066 .2
2306651
3670.41.6
461302
3229.114

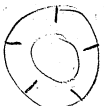
3229 | 33.000 | 10.2
3229
7100

3690 | 33000 | 8.9 per H.P.
29520
3480

3279 ft. lbs
10.2 per H.P this shows
that the fields are weak

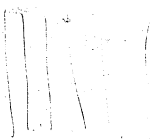
140

Armature. Two inches of plates .140 inches thick cut



240

after 15 minutes 50°C
Rise 26 °C



Test of wire
for 5 in order

Diameter .124 in

.125
.125
.124
.125
.126
.128
.1255
.125
.125
.126
.125
.127
.1255
.127
.1225
.124
.126

15) 135
90
35

.0042 .125 2

80 feet

9.83 Ohms

80

15625 | 78.640 | 50

78225

4150

18.3 C

5126

52

9

468

32

78.87

7.3° C Rise of box

9.71 annealed Cu.

.00031

7.3

93

217

.00226

.05

.00113

5

.0501

9.71

75

4855

6797

15625 | 728.25 | 466

300

62500

103250

93745

95050

A wire of pure Cu annealed 75 feet long at 0°C has a resistance of .0466 Ohms

26° C

.00382
26
2292
764
.09932
.00085176
.100187

26
26
156
52
676
.00000126
4056
1352
676
.00085176

0466
4666
at 26°c .0513 Ohms

The Cu wire to be tested had a resistance of .05 Ohms

24
24
96
48
576
.000000126
4456
1152
576
.000735 76

.0466
.0924
1864
932
4194

.04666
.0917
32662
466
4194
.04213 22
.00430584
.04666
.05096 Ohms

00382
24
1528
764
.09168
.00073
.09241

.05096
.0509

.0501 | .0509 | 101.4 %
.050 1
800
501
2090

Thr K

.127	80	
.125	126	
.126	124	
.127	17/90	83
.124	85	
.124	50	
.125		
.125		
.126		
.127		
.124		
.124		
.125		
.125		

75 feet 3/4 inches
wire .1253 inches diameter

foot grams 240 C
" .2328 ohm 1
3 Weight 3 lb 10 3/8 oz
48
10.37
5837 oz of wire

5760
175
28800
40380
5760
194 | 1008600 | 7004
1008
600

7004 grains in lb troy
16 | 7004 | 450.2 grains in oz
64
80
80
400

58.37
450
29185.0
23348
26266.50

foot grain .2328
75.3
6984
11640
16296
17529.84
75.3
5356
8760
12264

26266.5 | 1319.3560 (50.2
1313325
603100

.0502 Ohms by weight
.0509 " " size
.05 " " actual

Mr. Edison

Average Diameter .1252 inch
Wire slightly oval in
form and varied from
.124 to .127 in. in diam.

75 feet 3 inches gave at
24°C a resistance of .05 Ohms
and weighed 3 lbs. 10 3/8 oz.
Comparing with Matthiessen's
table given in Jamieson's
Range the wire is
100.5% by weight
102% by size

H

1.10 Method for testing wire.

First carefully measure the resistance of a length such that it easily can be easily laid on the laboratory floor and with a strong battery on the bridge make the resistance an even number of ~~ohms~~ $\frac{1}{100}$ / $\frac{1}{10}$ or 1 ohms. by putting in more or less coil. Call it r'. Then lay the wire straight on the floor and carefully measure its length. Note the temperature of the floor and air of the room. The correction for the box will be .00031 for each degree Centigrade above 18°3.

$R' = r'(1 + .00031t)$

R' = ~~Test~~ resistance corrected to t

r' = measured "

Gauge carefully the diameter of the wire at regular intervals along its whole length. The resistance of pure copper may be formed from these data. As all copper wire is annealed which is used for electrical conductivity that may be taken as standard.

Jenkin page 251 gives the resistance ~~for~~ at 0°C of a wire one foot long $\frac{1}{1000}$ inch in diameter as 9.718 Ohms on the authority of Matthiessen.

For any other length or size of wire the

resistance at 0°C may be found from the formula

$$r = \frac{9.718}{d^2}\, l$$

d = diameter wire in $\frac{1}{1000}$ inches

l = length " feet

For other temperatures the formula gives

$$R = r(1 + .003824t + .00001126t^2)$$

gives the true resistance

r = resistance at 0°C

t = temperature Centigrade

$R : R' :: 100 : X$

$100\frac{R}{R'}$ = per cent of conductivity of the wire to be tested

2nd Method by weight 113

Weigh the wire reduce to grains call it W.

7000 grains = 1 lb. Adv.

$\frac{7000}{14}$ (450 grains = 1 oz. Adv.

$\frac{50}{50}$

Measure the length as before of an even number of decimal parts of an Ohm denominate it L

The resistance of an annealed wire 1 foot long weighing one grain Jenkin Page 251 is .2064 Ohms

Correct this for temperature according to the formula given also correct the measured resistance for the change in the box as given designate as R'

10. The resistance of pure Cu
~~R~~ a pure copper wire
of equal length and weight
can be found from the
equation

$$R = \frac{.2064\,(1 + at + bt^2)}{W}\, t^2$$

Then $\frac{R}{1.00} = \frac{.2064\,(1 + a\,t + b\,t^2)}{W}\,\frac{e^2}{w}$ = Conductivity per cent

To change the formula
$R = r\,(1 + a_c t_c + b_c t_c^2)$ from
Centigrade to Fahr. t_f = temp. - 32

$a_c t_c = a_f t_f$

$a_f = a_c \frac{t_c}{t_f} = \frac{5}{9} a_c$

$b_c t_c^2 = b_f t_f^2$

$b_f = b_c \frac{t_c^2}{t_f^2} = \frac{25}{81} b_c$

$a_c = .00382$

$a_f = .002120$

$b_c = .00000126$

$b_f = .00000039$

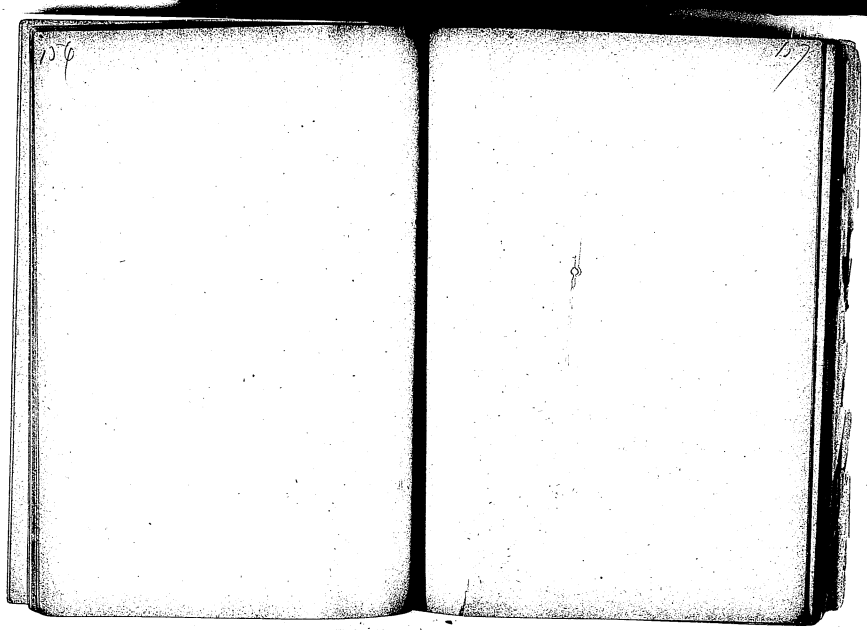
Fahrenheit

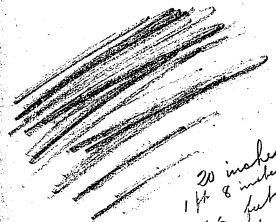
$R = r\,(1 + .002120\,t + .00000039\,t^2)$

9 / 60382
00042 4
5
.002120

81)126(155
81
450
405
45

155
25
775
310
3875



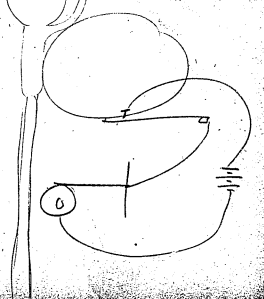


00034

20 inches
1 ft 8 inches
1.66 feet
.83 feet

52 tons
2240
52
4480
11200
116480
.00314 1
.00314 86
1 5 4 8
4 6 5 9 2
4 6 5 4 8
1 1 9 4 4
3 4 9 . 8 6 3 6 8
365 lbs

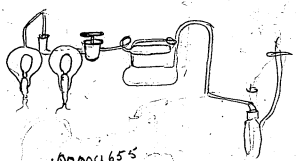
.020
5
.0003141
.003141



160 .00004655

161

.0254
25.4 mm



.00004655

245	117		
265	114		
270	117		
285	119		
310	122	270	132
300	132	235	128
300	182		121
240	127		
340	126		
225	142	320	139
240	142	415	145
270	147	415	147
250	145	260	147
270	138	240	135
275	145	250	136
300		250	147
		247	142
		250	135
		235	145
		245	142
		240	149
		270	135
		230	134
275	160		
370	163		
300	197		
275	230		
240	199		
285	167		
250	195		
250	180		
250	160		

Old Lot

6

295	157
300	150
340	150
300	157
275	153
255	150
265	157
265	157
245	155
245	152
275	155

21 of 143.
11 of 153
8 of 126
4 of 117
9 Vermonissay 185.

164 Testing

Dosson machine = two armature
Sutton
magnet

~~For 7 H.P~~
7 H.P consumed outside 10-11
.7 inside

Run machine at 1250 revs
The higher the speed the better
showing. The amount consumed
on the magneto remains the
same, the friction in the bearings
increases proportionally while
the magnetic and converting
power increase as the
square of the speed.

Find form of Proxy from C.J.
Appleton

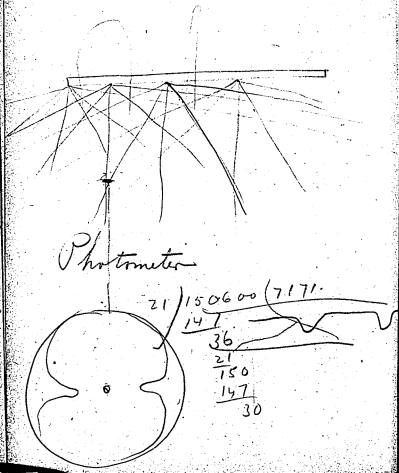
Figure out Elec. Connections
and method of measuring resis-
tance when hot.

Prepare condenser
electrometer
high resistance

Test fibre lamps

Test scale to see
if all right

16 Seat resistance box



Photometer

21 | 150600 (7171.
147
36
21
150
147
30

1250 Revs

Friction	7.000
Magnetic Friction	4.000
Commutation	1.000
Out of balance	1.000
Ringnuts	3.300
	16.300

20 to 1

Resistance machine .14 ohms
20
2.8 outside
14
Total 2.94 Ohms

E. M. F 100 Volts.

294) 4480000 (15240
294
1490
1470
2000

33) 150600 (4

16

170

Wire on armature 7171

150600) 16.300.00 (108
150600
1740000

89.2 % Converted

16300
7171
150600) 23471.0 (15.6
150600
841100
753006
88100

84.4 % outside

84.4
9.4
3376
7596
7.9336

96% Exclusive finite

6000

177

Winding machine for 1850 watt

Each wire $\frac{5}{4}$ as strong

$\frac{8}{10}$ the number of ~~coils~~ turns to give the same E. M. F.

$\frac{8}{5}$ the number of coils to of one turn each

each coil $\frac{5}{8}$ the ~~wire~~ present width 000 $\frac{5}{8} = \frac{15}{24}$ $\frac{2}{3} = \frac{16}{24}$

$\frac{5}{8} = \frac{45}{72} \frac{15}{24} \frac{6}{9} = \frac{5}{7}$ $\frac{48}{72} \frac{16}{24} \frac{2}{3} = \frac{16}{24}$

75 X $\frac{8}{5}$ = ~~200~~ 120 coils

118

Resistance each turn

$\frac{3}{2} X \frac{1}{4} = \frac{3}{8}$

$\frac{8}{5} X \frac{3}{8}$ = Resistance machine

$\frac{3}{5}$ the resistance of the other

$\frac{3}{5} X .14 = \frac{42}{5} = .084$ Ohms

~~Machine magnetized~~

If the two layers can be ~~put together~~ have double the wire in them the machine will have .07 Ohm $\frac{1}{2}$ present machine

Armature 1014 Plain
1001 Twine paper
see page 217
Four thicknesses of cloth

28° C Warm from former 6p.

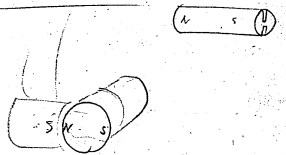
after 45m 36° C 8° Rise
1h45 43 7° 15°
8 hours 52 C

Cover taken off 4 A.M
after ~~5:30 A.M~~ 42°
6 A.M 37°

Round wire
old machine 4 layer cloth

10		24° C
10-50		60° C
11-50		72° C

Axles cool



10 lamps 9 in H. P.
90 ohms each

9 ohms total

.15 | 9

Shim plate .014
Fiber .061

Pages 217 tests
174

Dimensions

Magnets

bore 9.75

Armature space between flanges 8 inches
Lenght over all 8.375
Weight Total 107 lbs
Less wooden core and axle and [illegible] 26
81
No. plates 524

Diam core wooden 6.25
Diam iron 9.18

34
34
136
102
1156

117
117
819
117
117
13689

1156 / 13689 (11
1156
2129
1156
973

3

331
33
99
99
1089 / 13924 (12
1089
3030

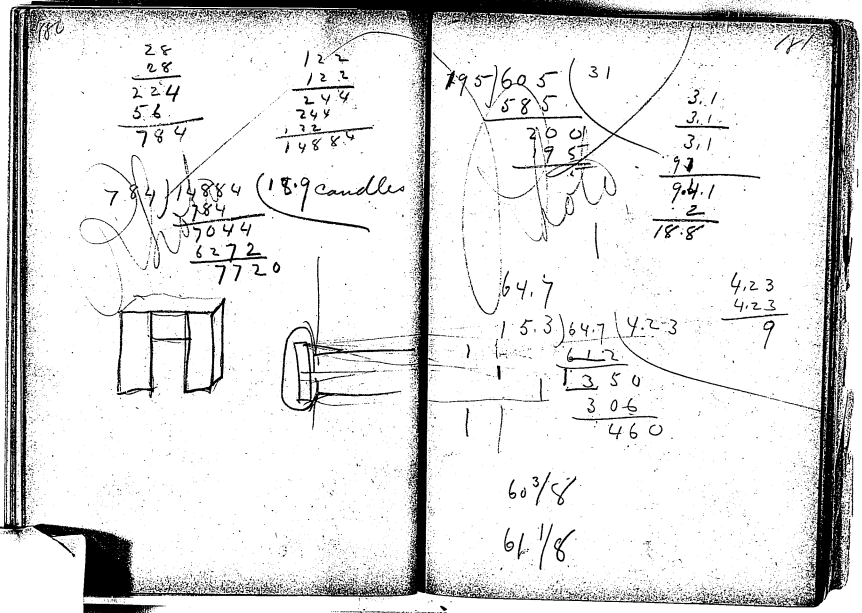
118
118
944
118
118
1392 4

3 / 118

49.7
50.55
52

33
33
99
99
1089

118
118
944
118
118
1089 / 13924 / 12.85
1089
3035
3267
856


28
28
224
56
784
122
122
244
244
122
14884
784 / 14884 (18.9 candles
784
7044
6272
7720
195 / 6085 (31
585
2001
1951
50
3.1
3.1
3.1
93
9.4.1
2
18.8
64.7
15.3 / 64.7 (4.23
61.2
3.50
306
460
4.23
4.23
9
60 3/8
61 1/8

Tissue paper from screen total failure

61.1
18.9) 61.1 (3.23
56.7
4.40
3.78
620

3.23
3.23
969
646
969
10.43

20.8

605
195) 605 (3.1
585
200
195

3.1
3.1
31
93
961
192.5

57.6
24) 57.6 (2.57
48
1.28.0
1.12.0
1600

2.57
2.57
1799
1285
414
5604 9
2
11.2

47.3
32.7) 47.3 (1.4
327
1460
980
9

1.4
1.4
56
14
1.96
2
3.92

18.7
41.3) 18.70 (.45
12.52
21.80

.45
.45
225
180
.2025

60.35 / 14.5 | 6035 | 30
5895
1400

65.52 / 14.8 | 6552 | 44
592
600
44
44
176
176
19.36

63.36 / 16.4 | 6336 | 39
492
1440
39
39
351
117
1521

59.99 / 201 | 5999 | 298
402
1970
1509
161

5.91 / 209 | 591 | 283
418
1730
1672
680
283
283
849
2264
56.6
80089

56.6 / 234 | 5661 | 242
468
980
936
44
242
242
484
968
484
58564
2
11.9

18.6

~~Three~~ One machine 40 volts

~~Hundred~~ candles 49.7
303

Three machines 40 Volts

~~Candles~~ 5.5.5 | 50.05
29.4 5

One machine 40 volts

52
28 | 52 (29
35
60

Three machines 40 volts

52
80.45

One machine 40 volts
49.8

~~50~~
49.7
303 | 49.7 (1,64
303
1940
1818
1220
Candles

164
164
656
984
164
26896
2
5.36

29.4 | 50.05 (1
294

28 | 52 (1
28
24 0

15

12 ad

33000
8
26400

110
110
121 00
4 4 2
36200
484
484
536030

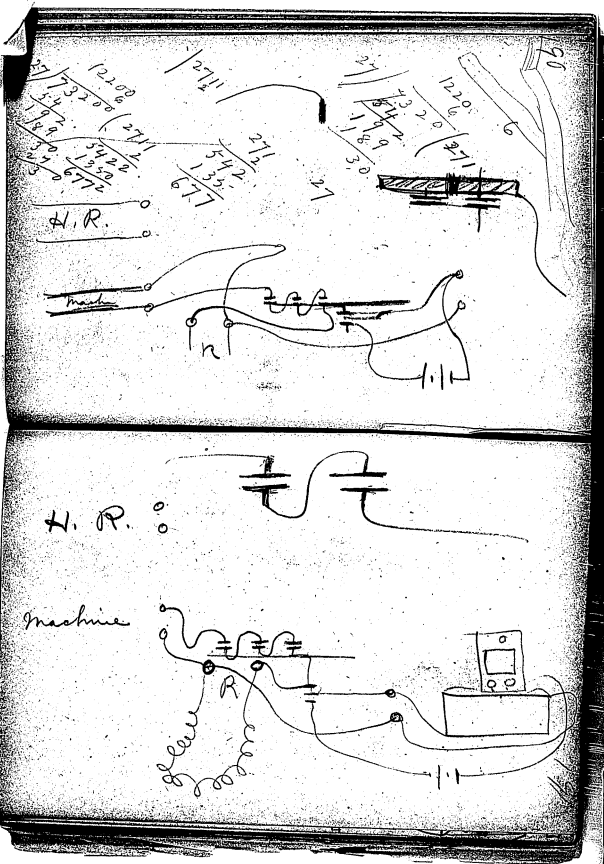
264) 536 (2 Ohms Total
for 8 boxes

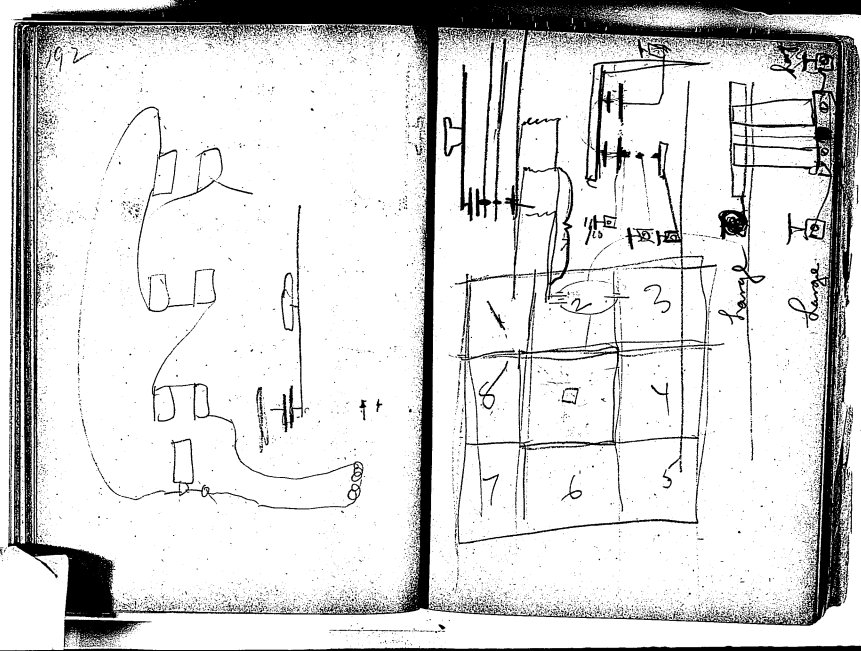
175 Ohm

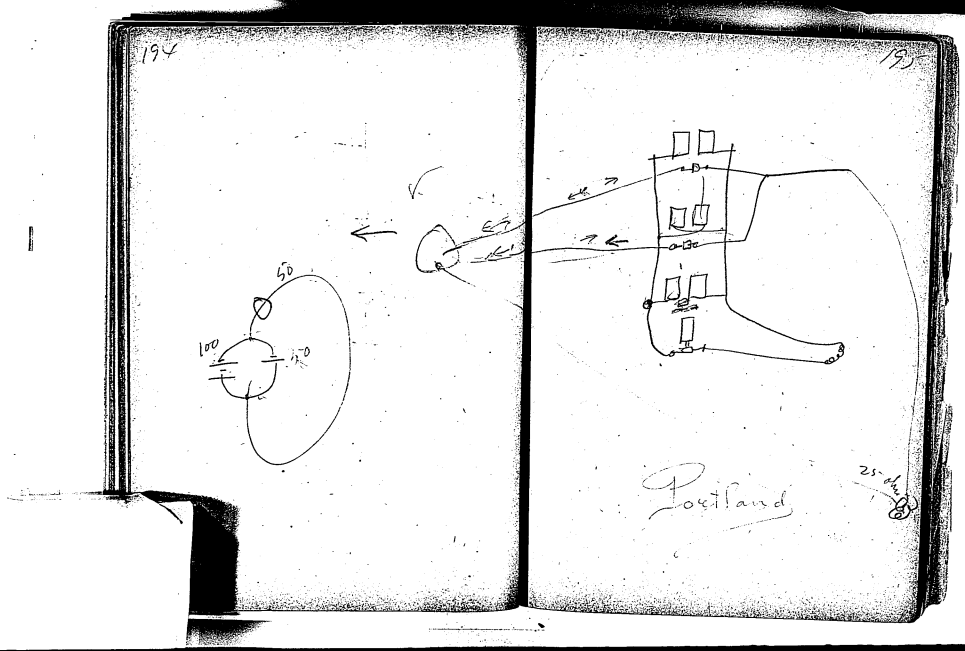
3 Ohm boxes

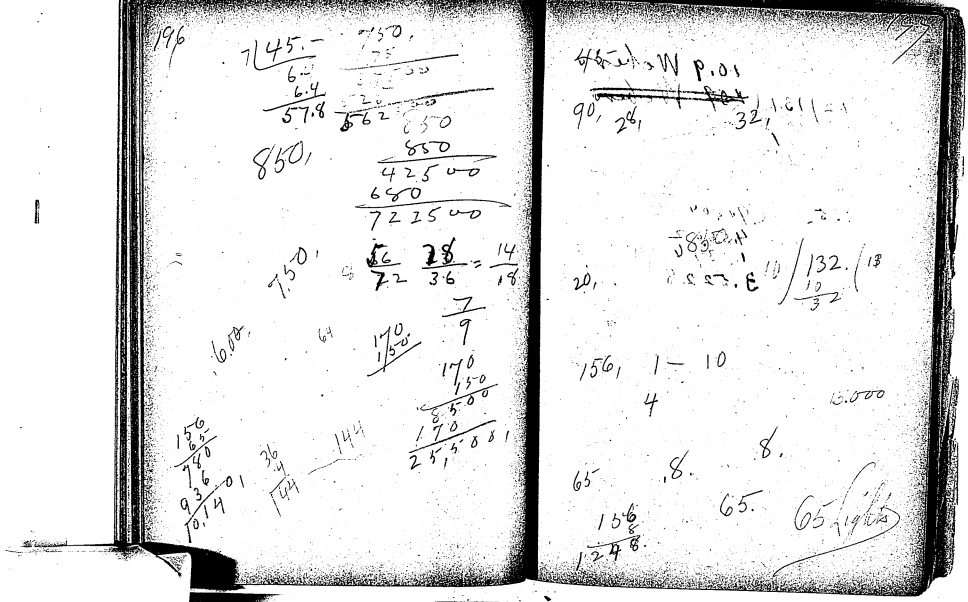
16 boxes side by side

Radar table rearranged


H. R.
Machine
R


192
1
2
3
6
4
7
6
5
large
large


194
50
100
150
Portland



198

10.9 Webers

1.2 / 13.1 (~~12.6 Webers~~)

12

1.10

108

20

7° 35' (94.04

4.560 2

1.037 4

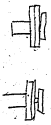
3.522 8

Constant dyne 79

7° 35'

13. Volts over 1.2 Ohms

1



200 11-20 P.M. Feb 4.

The armature of plates impregnated with fibre with a covering of cloth in a field coil and makes 85 Volts with 40 lights on a .14 ohm machine 1 88 lbs of Iron

11-20 Temp. 24°C

11-35 37°C

Starter

11-42

12-12 53°C

12-18 29

12-48 59°C

12-53 68°C

1737

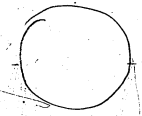
Started 1-34 A.M

2-04 69°C

Cooling

2-30 64°C

5 a.m. 40°C



Machine .54 ohm wound iron wire supplying 24 lights .55°C

202

772
9
5 | 6948
1389
88
1389
5

1389
1/2
2778
1389
166.68
166
80
00

45 | 290 (1.64
270
200
180
200

15

1389

53
24
29

24
9
5 | 216
43
32
5
52
127

70

1389
1/2
166.68
80
13334.40

29
9
261
52 1/3

1/25

1/3.5

2/7

1/3 Horse Power

10 lamps

H.P 3 Volts

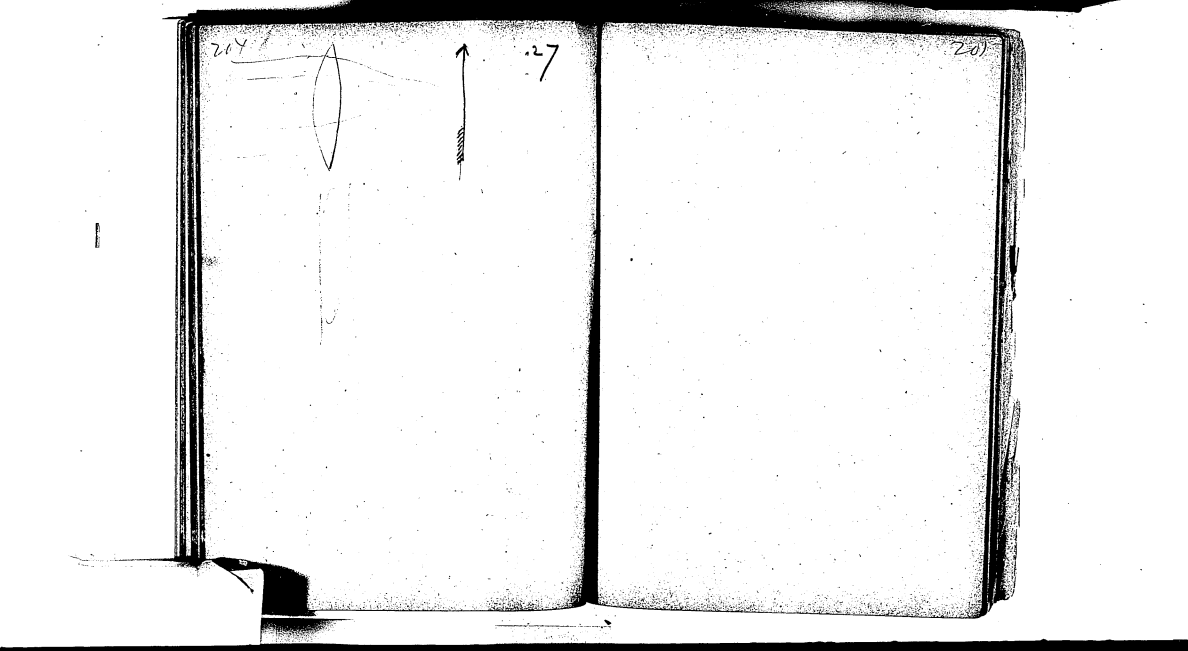
30 3.96 Foot pounds per minute

166.68
.88
13.3334
13333
146.6668

14.666
.64
58664
87996
9.38724

9380 | 33000 (3.5
25
50 20

203



Armature with painted plates

~~2-12 A.M.~~ 22° C

2-42 A.M. 38° C 25"

3-7 A.M. 22 16

3-13 A.M.

3-33 A.M. 47° C 22 25

six minutes

3-40 A.M. 60° C 22 38

4-10 A.M.

4-17 68° C 22 46

4-47

4-53 70° C

5-08

15-15

5-30 71° C 22 4.9

Comparison Increase

Without paint With paint

Face 22° beginning Face warmer End 32° C

1/4 hours	(1) 13°	25 minutes 15"	16°
	(2)		9.6
3/4 hours	29°		25°
1 1/4	35°		38°
1 3/4	44		46°
2 1/4	45°		49°

~~22~~

after 12 hours ~~84°~~ 87° 24 63°

25 : 15 :: 16

10 20 12 300 19.6 21

The first fifteen minutes would seem to give fairest test and that shows that the painted as against unpainted there is a gain of 33 1/3

208

88 lbs cast iron

12

176

88

10.56 thermal units

1.8 772

18

6176

772

13896

105

6945

1389

14584 5

14585) 33000 (2.27

29170

38300

29170

91300

1

2.27 H.P = .440 H.P

Feb. 9, 1880 209

Split rings with air spaces and gups placed on the outside to force air in

10-6 P.M. 30°C 15 minutes

10 21 63.5°C 33°.5

10-28 P.M. 1/2 hour

10-43 75° 45°

10-50 P.M. 3/4 hour

11-5 89° 59°

11-7 1 hour 1/4

11-37 100 70°

11-42 P.M. 1 hour 1/2 73°

11-57 103°C

10
4
5

12-3 1037 -77

N.S.

The plates probably connected by means of the ~~the~~ bolts connecting and the wires separating them so as to form a short circuit for the current generated in the armatures. The outside ring also probably acted as a shield to the inside and saved nearly the full force of the currents induced and stored the heat very.

212 Arrhenius made of iron plates .037 inch thick bolted together with brass rods insulated from the ends. Large iron plates on ends insulated. Plates very much oxydized MnO2 and ½ oxide. 186 plates

9-48	P.M.	25° C	15 minutes
10-3		30.2	5
10-11			30 minutes
10-26		36°	11
10-36			45 minutes
10-51		40°	15
10-59			1 hour 15
11-30		46°	21
11-41			2 hours 15
12-41		55°	30

186 | 9.00 | 48 Measure from inside
744 | .048 each
1560
1488

12-50
1-50 61°

~~8-12 1-36 PM~~

Summary

15 minutes	5
30	11
45	15
1 hour 15 minutes	21
2 hours 15	30
3 hours 15	36

214

Mr. K. .037 plates

Please count and weigh the plates on both armatures and also measure the distances from insides of outside thick iron plates from each other

Paint the thin plates Bronze. Some means so that there can be no metallic contact between any of the plates, that is so that each one will be insulated from each other. The brass rod running through them as I said I think. H. Phipps.

Feb. 14 1900

Mr. K. .037 plates 214

198 rings Total 85 lbs

Average thickness .032

Weight Thin rings 71 lbs

" Thick Disks 14 "

Distance between Disks 8 in

Thickness of two disks 8.83 "

Thick plates armature same space weighs 75 lbs. (74.1lbs) discs on ends 14 lbs

Total 89 lbs

216 .037 plates

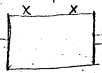
According to weight of metal the thin plates should give

89 : 85 :: 100 :

89) 85.00 (.95 Volts
801
490
445

1/2 the heating on the thin plates

Feb. 14, 1880. The thin plates were painted and put together. The resistance from x to x was .08 Ohm



Tissue paper placed between each plate. R = .36 ohm

The burrs from cutting the plates were carefully filed away so that there was no connection through them in each of this experiments

.037 plates

		Rise
2.00 P.M.	24° C	
2-15 P.M.	29° C	5° 5°
2-11	35.5 C	6°5 11.5
2-47		45 minutes
2-59	41°	5°5 17°
3.50		

.014 plates

The machine + [illegible]

.014 in plate
.001 Tissue

24°		
26° after 15 minute	Rise 2°	
32° " 45" 1.45	" 6°	8°
36°	4°	12°

1/10 H.P.

See Page 174 for test with clutch

18 5°C Rise of 85 lbs of water

1°C rise 1 lb of H_2O = 1389 ft lbs

5° in 15 minutes

1/3° = 1 minute

1389 × 10.12 = 14167.8 ft lbs.

85 × 12 = 170, 85 × 10.20

14167 ÷ 33,000 = 4.722 (62.33)

28334, 46680, 423, 438.

$\frac{1}{2.33}$ H.P. for 1°C

$\frac{1}{6.99} = \frac{1}{7}$ H.P for 1/3°C

= .143 H.P.

3 | 14167

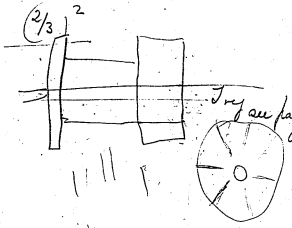
4722 ft lbs

Suppose 100 Volts E.M.F. 2/7

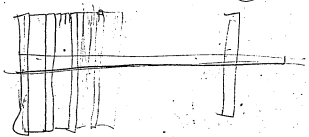
75 coils each 2 turns

$\frac{2}{150}$

2/3 Volts = E.M.F of one turn



Over page 140



220 Thick plates with three
layers of tissue paper between
them the same as tried
forge 206. 1050 Revs. Magnet
the same as in practice

			15 minutes
4-50 P.M.		23° C	
5-05		34° C	11°
			45 minutes
5-13 P.M.		49° C	15° 26°
5-43			

Five brass plates [illegible] and clamped together resistance of all 1/2 ohms

Armature made of long strip wound in the form of a spiral iron .032 inches thick. Weighs lbs

The ends were insulated by paper two thicknesses of paper and placed between the iron plates and the iron and brass [illegible] plated on the iron plates. The strips were wound with five thicknesses of paper between them. Seven Ohms in three fields

9-23		26°	
9-32	Smoking!	86°	66°

9160°
6.6

14163..
66
86976
68976
33 | 97873.6 | 3 H.P. about

7.2 Webers on field

122 Mr. Edison wants the armature with the spiral wrapped. The paper insulation between the strip should be 1/8 longer than the iron. The coils to avoid rough edges in the iron to be smoothed. Every precaution to be taken to insure perfect insulation & must work

Suppose short circuiting 1/10 H.P 33 00
Armature 1/10 33 00
Friction 7000
Commutator friction 2000
Magnetic and material friction 1560
Field magnet 1/6 5500
21.100

50 Lights .14 Ohm machine

14)200(14.3)165 160
14 12670
60
56
40
13)165000
13
35
26
90
78
120

6 H.P = 198.000
21.100

50 lamps 3300 each 165000 H.P.
Wire in machine 12,670
Short circuiting &c 21,100
33 770
50 198,770
3,975

3,975)33000(8.3
31800
1200

8.3 Net

Conductors 198770
1.6 5000
50 215.270
4305.4

4305)33000(7.6
30135
28650

220

22

Shafting Engine from Indication to belt

215-270
21527
5% | 236797
4735

4735) 33000 (6.9 per H.P. Net
28510
44900

Inclusive friction
91.2 %

Converts
165.000 Lamps
12.670 Wire in machine
177,670

177670) 15600.00 (.088
141366
146400
141366
5.6400

14) 88 (6.2
84
40
28

.088

88.8 %

12,670
7000
165 on | 5.670.000 (90%
1500
6 40 000

12670
7000
165 on | 5670.000 (03
55 5000
120

97% Exclusive friction

This shows 7 net from 10 in the current, from the indicated horse power of the engine or 8 net if from the belt

.14 Ohm Machine

125
1.4
500
125
175 0

.175 Ohms Machine at 85°C

10 Lamps 100 Ohms each

1/10 H.P on each

1 H.P. 10 Ohms outside

.14 X 1 H.P. on machine
10.14

330000
.014
132000
33000
462.000 ft. lbs. per minute

1°C rise in armature

Page 218

14,167 ft. lbs

9 lbs of Cu

.095 × 8.85 = 1389 × 855

6945
6945
11112
ft lbs. 1187595

Total 14.167
1.187
15354 ft. lbs. 1°C

Page 207

16° in 25 minutes

25)160(.64° per minute
150
100

14167
.64
56668
85002
9066688 ft lbs per minute

228

9066 ft. lbs. per minute to hold the armature at 87° C
63° above air

9066 : 462 :: 63 :

87
3724
3616
108
9066

462
63
1386
2772
29106
28998
1 2600

(301

3°.11 rise for 10 lamps

20 lamps
12° rise

462
4
1848 ft. lbs.

40 lamps
48° rise

739 2/4 ft. lbs.

100/40 = 2.5 Ohms

Machine hotter say .15 Ohm

.15) 2.5 (16⅔ to 1 Ration
1.5
1.00
.90
.100

58 lamps
.17 Ohm

1.7) 100 (58 lamps
85
150

5.8 H.P. consumed lamps
.58 " " Machine

23000
.58
264000
165000
19140 0 ft lbs on machine

9066 : 19140 :: 63
63
57420
114840
9066) 1205820 (131°C Rise ?
90660
29920

This results is not true since the .156 Ohm machine will run 30 lights and not grow very warm Nothing like 130° C above the air

Experiment to try
30 light
30)100 (3.33 Ohms
~~On external~~ circuit and run the machine 87.4 Volts

63)9066 (144 ft lbs
63
276
252
246

144 ft. lbs. per degree C.
1000 per minute

Armature ~~Bracket~~ immersed half full with square wire insulated in layers from each other like Rheostat coil

24° after 15 minutes 60°

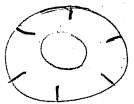
Rise 36°

15 minutes more

Rise 56°

The solder could not be taken off from the outside

See page 140 for test



Solid iron armature 10½" long 1½" thick

$\frac{83}{26}$ 57°C in 13 minutes

57° in 13

13 : 15 :: 57° :

$13\overline{)57\tfrac{1}{2}(4.4}$

$\underline{52}$

$5\tfrac{1}{2}$

The armature with .037 in plates ran 75 lights with an E. M. F of $\frac{285}{3} = 95$ Volts for three hours and heated to 100° C. This is the least ever done in the world and brings us home with this size of machine

11

Test of copper wire

Three feet of wire weighs 1180. grains
Covering weighs 33.3 grains
Covering 3% in weight of whole

.06 Ohms at 19.5 C below. the coils
20.5 C at the top of the coils
20° average

101 feet 2 inches of wire

1180) 33.30 (.003
33
300

Diameter of wire
about ten feet apart
9 inches

.132
.132.5
.132
.132
.13225
.132
.132
.133
.132

20

Average .1322 inches

Five feet of wire weighs 1845.5 grains
" " " " 1839.7
" " " " 88385
Fifteen feet of wire 3 | 55227
1840.9
Covering weigh 168.5 grains
55.227 | 168.500 3.05 %
165681
291900
3.0 % for covering

$\gamma = \frac{9.718}{d^2} l$

$d = 132.2$
$d^2 = 17476.$
$l = 110.16$

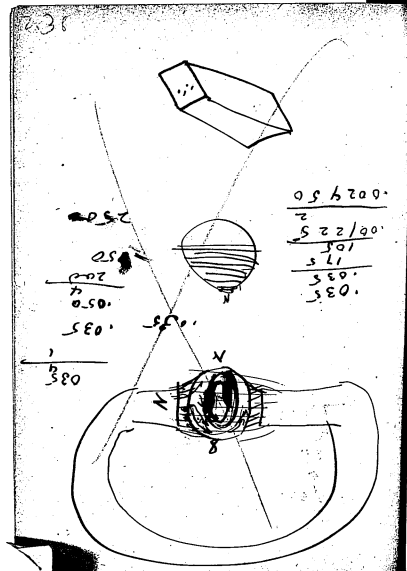
132.2
132.2
2644
2644
3966
4256.84
1322
17476.

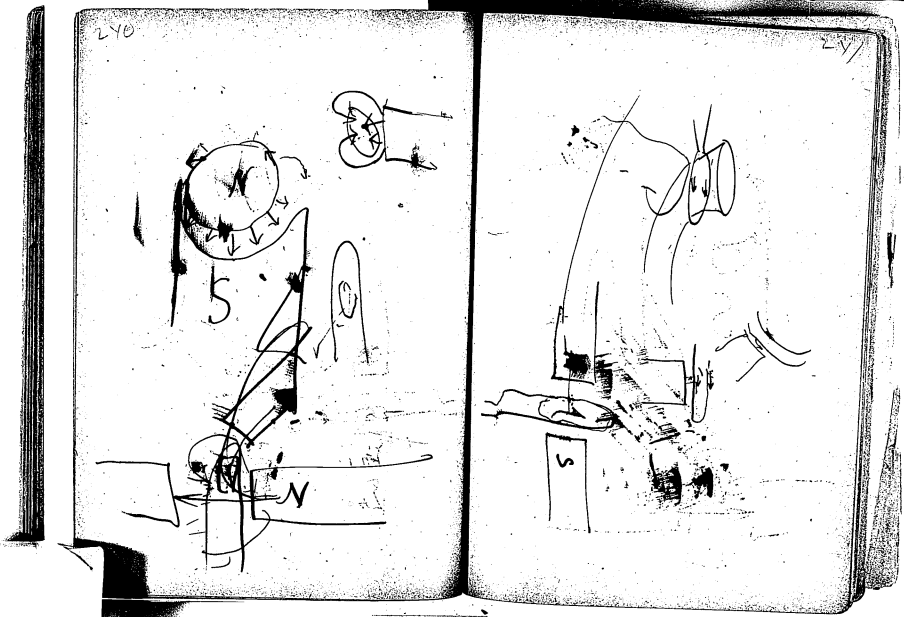
4256 | 9.718 | 002283
8512
12060
8512
35480
34048
1432

5321 | 1000 | 16
1.002283
6
6 68
6 38
2 30
2 21
9
5321 | 5.032

17476 | 97.180 | .0005560 →
87380
9800
87380
10420
10480
4440
55227
16855
88691.7 | 1685.00 | 2.96
11382
54680
51219
3.4610

2.96 % of total is in the covering.




240
241
S
N
S

$K = 5^{-}(1 + .00382\,4^{2} + .00000\,1^{2}\ldots)$

.00382 4

r = .06125

.076488
.06125
.382440
153296
7648
.00468 4 .0 0 6
.06125
.06598

20
20
400

.00000126
400
.00050400

Five feet of wire weighs 1841 grains
Cu. ft. of wire weighs 555 lbs
Cu. ft. of wire weighs 555 lbs
1728) 555.0 (.3211 lbs in cu. in.
5184
3660
3456
2040
1728
312
7000
2247.7000 grains in lbs
60) 184.1
180
4.1
3.0.68
22.35
2247.70 (100.05
2247
0
7000
6735
2650
2247
403
3.14) .00995 (.00316 = 3/16 inches
94
50
31
190
187
3
Wire 1/2 inches
smaller than Molesworth's diameter

Troy weight
Av. weight 153

15) 101.16 (6.744
90
11 1
10 1
16
33/36 2
55227
55227
55227 Total Wt. Grains
15) 558671 3 3 2 (372448
45
108
105
36
30
67
66
78
2247) 30.68 (.0136
2247
8210
6741
14690
13455
1235
90
Molesworth Diameter
.1318 inches

l 101.16
101.16
606 96
10116
10116
10116
l² 10223345 6
2064
40932
61398
20466
211 21 0
3.7245) 2112.00 (.0564
186125
250750
223510
272400.

r = .0567
.0765
3955
3402
3969
.004348 75
.0567
.061 Ohms Phila sample

.060) 061 (101.6 % by weight
60
100
60
mm

.060) .06593 (109.9% by eigt
60
593
540
53
Sl. Gr. 8.96 Emerson

These results seem impossible yet great care was taken. The tape was new by which the length was measured and the wire was most attached kept measured by laying the tape at its side.

Sample for Dynamo 16.62 lbs
169 Feet of wire at 61.97°.
.0411 inches in diameter gave a resistance of 1 Ohm

411
411
411
1644
168921

9.718
169
87462
583 08
97 18
1689) 1642374 (975
15201
12234
11943
8010

.003824
16.6
22944
22944
3824
.06347 84
975
3170
4438
5706
6481 50
975
103.6 %

2 16 166.25 feet of wire 413/1000 in diameter at 62°57 gave a resistance of 1 ohm

413
413
1239
413
1653
1705.69

1705 | 16227.6834 | 95.2
15345
8820
8535
2850

9711.8
1663
29154
58908
58908
9714

.0634
952
1268
3170
5706.
60.2968
95.2
101.2 Ω

Test of Paradis machine 2-17
.037 plates 1100 Revs

W7 running field open
Card No. 1,2 1,020 Ohms.
In the line 2.66 Ohms.
time 2.23. P.M.
2.26. P.M. No 3. Card.
On high resistance 336 = Deduction
Dynamometer 8.20. Ohms
In the line 3.05. Ohms.

Cards taken from the crank side of the pistol No. 1. 2. 3. 4. 5.
Armature making 1127
1126. R.P.M.
Main shaft making 186. R.P.M.
366 R. in two minutes
Dynamometer 1,000 Ohms. field on
1,010.
Card 6. 7. 8. far end of cyl.
Dynamo on.

248 1/2 Angle between belts 22°

Steam cyl. 16" bore = 201 sq. " area
42" stroke at 60 revs; average speed = 60 x 7 = 210 ft.
Card No 1 - average pressure 48 lbs. per sq. inch.
" No 3 135/20 = 6.65 lbs. per sq. inch.
No 6 6.8 lbs per sq inch
No 9. 4.3 lbs
X 2

207
248
80 40
402
48240
48
385920
192960
230.0185.20
198
325
307
85
48240
6.65
442300
289440
289440
3228070
297
288
231
270
322807
230552
192245
Indicator 209.360 ft. lbs -

230 TYS 1/2
461110
6.92 H.P
2
13.34 H.P.

6.65 CS
48 48
185 2.5
1.55
4.35
2.17
48240.
2.17
337680
48224
96448
10468080
2
208.360 ft lbs
6.78 H.P.
6.92
2.86 H.P. Dynamo

Dynamometer 185 Belt Shaft speed

Circumference pulley for belt 10.02 + .09 = 10.11 feet

38 119.3

38⅛ 120 / 1.7 inches for belt

11/12) 1.10 (.09
108
2

Angle 22° Cos 22° = .927

927) 1000 (1.08
927
7300

10.11
1.08
8088
1011
Corrected size 10.9188

10.91
185
5455
8728
1091
2018.35
200
2) 403600
33) 201800 (6.1 H.P.
198
37

112
112
224
112
12544
4483
376356
50176
50176
3 | 3556992
185233 ft. lbs. in current

.14 Ohm machine
about .11 in leading wires
.25) 3 (12

1/12 of this in machine and leading wires

12 | 185.233
15436
200669 ft. lbs. engine indicated
209 360 ft. lbs. given machine
202 700 ft. lbs. back in current
200.669 ft. lbs. measured galva.

Shop and engine running
461,110 ft. lbs.

Large armature thick
Poles. Surface spud =
Resistance of
new large Faraday Machine
2.1 Ohms.
Temp. 16° C.

9 A M Started

N = 270 from .030 Heater
20 cells Daniells 239 = N
N = 92 on magnet

20 | 239
11.9) 920 (773
833
870
833
37

7.73
1.54
6184
773
8324

9.45 A.M. 22° C.

Changed the field

240 = N from 20 Daniells
120 = N around magnets
9 55 to
10-35 Am. 28.0 Rise 6°C

Started 10-45 am.

20 cells 239

10-50 120 on magnet

12. m 33° C

Magnet face 23° C

This test shows that the field was very weak

Thurs 1-20 P.M.

Armature 31° C

Magnet face 22° C

4 per HP

32000
216000 ft lbs
4000 ft lbs per Hour

20 Volts

$\frac{20}{165} : 20 : 1246$

$246 \overline{)5000} (22$
$\underline{492}$
80

P.M 1-45 240 20 Cells

220 on magnet

June

2-45 Temp room 21°C
Armature 38°C
2-55 Started
226 = A around magnet
4-00 Temp room 49°C
Armature 43°C
4-10 Started
5-10 Temp. room 20°C
Temp armature 46°F

June

5-20 Started
8-45 54½°C
8-50 "
10 A.M. 56° C

188.
38

2.27416
1.57978
.49715
.02179
4.37288
8.92082
3.29370

12 | 23590
1

196600
5.878

Heating Exps

page 140
174
175
177
200
206
207
208
209
214
221
232
233
253 large

$$C(R+r+q) = \frac{C}{1}(P+r+q)$$

~~$CR+rc+qc = \frac{P+rc+qc}{1}$~~

~~$\frac{CR+rc+qc}{1} = \frac{P+rc+qc}{1}$~~

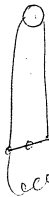
$\frac{CR}{1} = \frac{P}{1}$ ans

$CR+Pc$ $\quad CR+XL+qc = \frac{P_2+XL+qc}{1}$

276

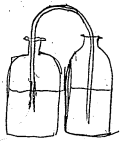
95
95
475
55
9025
44
3610
3610
6 | 39710
6618 3

21



6/596000
99333
6
595998

Order 2 lbs Sulphate Zn. C. P.
50 " " " Com
" 2 lbs Sulphate Cu. C. P.
Get Electrometer
Make 4 cells of C.P. material



280

145
745
725
580

145 23 = 95
210 44 = 45
140

.6,
8410 0
8410 0
700,

6) 9254 10
1541 83 — 2

33
4
132000
16500
748.500

0.

24

140
140
140
5-6 C
140
19744
324)350(
7896
7896
86856
144760

145
145
5=

195
195
975
1755
195
38025

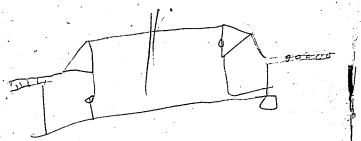
18
18
144
18
324

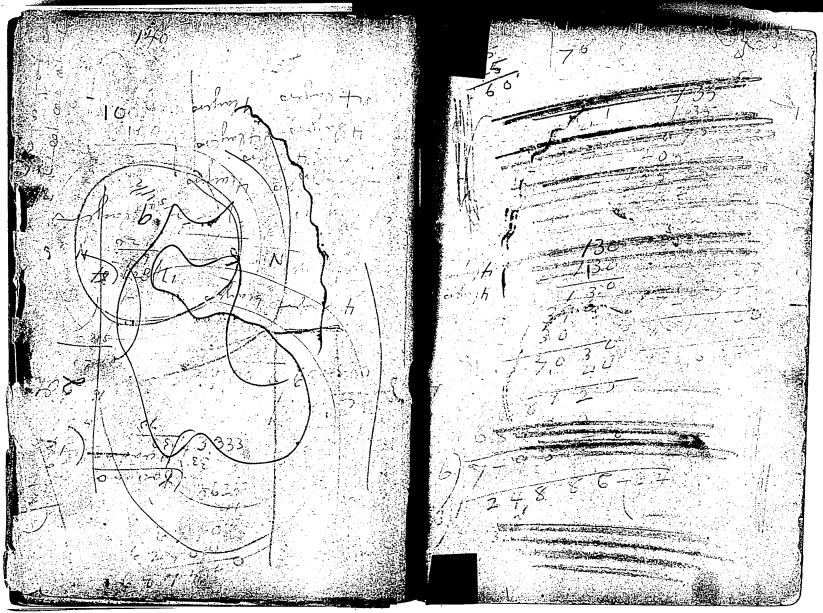
·326
60
19.560
19.56 mg

324)350(1.14
324
560
324
1360

33
4
132·00
16·50
148·50

33
5=
165.





Menlo Park Notebook #42 [N-79-12-19]

This notebook covers the period December 1879-June 1880. The entries are by Edison, Charles Batchelor, and Francis Upton and relate to electric lamps. Included are notes, drawings, calculations, and tests of lamps; a caveat by Edison; and drawings by Batchelor of a glass blowing machine for making lamp bulbs. There is also a set of notes about lamps burning at Menlo Park, which appear to be in the hand of Albert Herrick. The book contains 264 numbered pages.

Blank pages not filmed: 6-7, 28-29, 32-33, 46-47, 60-61.

Missing page numbers: 37-38, 261-262.

No 42

LIBRARY OF THE

BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

From Library of
A. G. Bateman
, 189 .

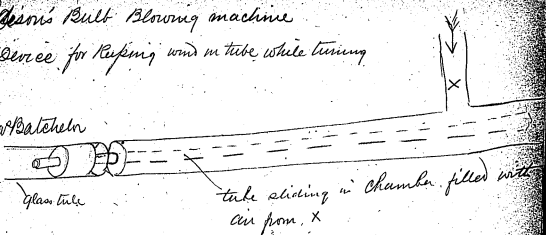
Brass Glass Reducing Washers for Lamp Bulbs See Pat. No. 419,874

Chas. Batchelor

Edison's Bulb Blowing machine

Device for keeping wire in tube while fusing

Chas Batchelor



100 thin
outside

FP
550

100
in Battery

550

100 thin 50 thin 2 sem
4900 — 2450

49
100
4900.

49
50
2450

50.
50
2500
44
10,000
10000.
200 / 11000.00

150 / 7333 (48
600
1333
1200
133.

125 / 11000.00 (880
1000.
1000
0

125

150 / 11000.00 (7333 1/3
1050
500.
450.
5000
450.
5000.
450

3666 4-0
7333
1099.9 5-0

Dec 28 1879

83
83
249
664
6889
441
27556
27556
3021.16

90.
81.00
461
32490
32490
3240

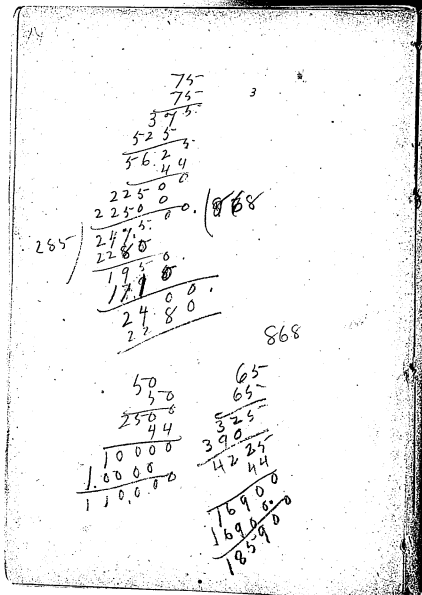
262 / 356400. (1360
262
944.
786
1572
1572
16

1360
24
5440
2720
32640

Portland Feby 6 1880

609-
Foot Lbs. ——— 1169. 28 per H.P.
Resistance. Hot 262 ohms Cold 480.

609- measured cold after running several hours was 480 still with 90 volts no change over 83 volts R was 264- shewing apparently that there is a point when elec af R stops ~~[illegible]~~ & increase commences with 90 volts 24 per h.p.



Feby 6 1880.

45-Vall 89100. R 365
50 " 110,000 R 327
55 133100 R 312
60 158400 R 306
65 185900

244 Hlbs
336. Hlbs
327 Hlbs
317 Hlbs

327 / 110000 (336
981
1190
981
2090
1962
128

306 / 158400 (517
1530
2700
2142
2340
2142
198

365 / 89100 (244
730
1610
1460
1500
1460
40

312 / 133100 (426
1248
834
624
2100
1872
228

100 / 89100 (891.

285 / 75
75
375
525
5625
44
2250
22500
22500
2475
2280
1950
1710
2400
2280
120

868

50
50
2500
44
10000
10000
1100

65
65
325
390
4225
1690
1690
1859

45
45
225
180
2025
44
8100
8100
891000

Aug 1st Test in chemical Laboratory of Edison Rec. 1,

Commenced running at | June 15/1880 9.40 A.M.

Taken over to office

55
55
275
275
3025
44
2100
12108
133100

60
60
3600
44
14400
1440
158,400

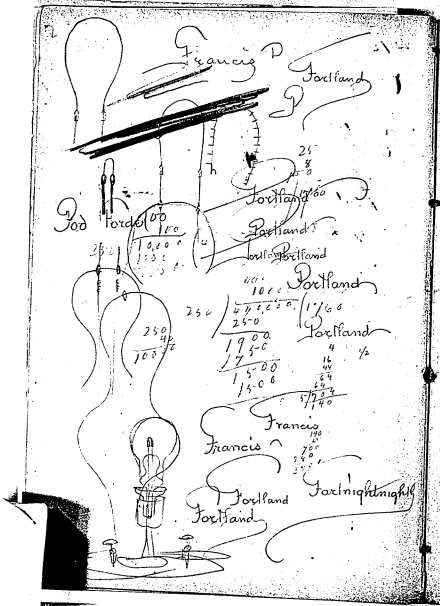
410 Pat- in chemical laboratory of
Edyson Rio.
Commenced burning at 9.40 AM Jan. 15 1880.
Taken out by J. Ward-Thomson

Dirt mining Lamps 4 ao 11 Quarry and Mine
mill 1 to long drill Jan 14 1880 Jan 15 1880 Jan 16 1880 Jan 17 1880 Jan 18 1880 Jan 19 1880
and Quarry work Jan 20 1880

419 Jas Chandler by agan
part in by — Watts side
Rec 128
Commenced Jan. 14. 1880
running at 4. 40 P.M.

Busted after running at 19h

403 for Chandelier Tg organ 22
put in Jy — at South side
Res. 142
Commenced running at Jan. 14/1850 4.40 PM.
Busted after running 2 3 hours



410 Hanging on overes by Mess.
Kennedy's work-hands in laboratory

Res. 117 — Jan. 14 1880
Commenced running at 10.00 P.M.

Test on three new pumps
by Mr Zaga

Jan. 3		19.30	
" 4		9.58	
" 5		23.47	
" 6		20.26	
" 7		12.15	
" 8		22.00	
15.	11.00	" 9	15.30 total time hand 173.12
16	23 00	" 10	19.15
17	11 00	" 11	7.00 " " 17 sam
		" 12	20.00
		" 13	22.30 " " 23.47
		" 14	22 30
		" 15	11 30 after noon 194.47
			226.31

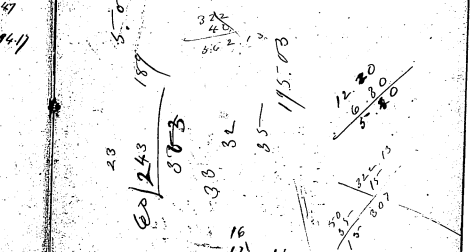
7.00	83.30
20.00	11
22.30	94.30
22.30	23.00
11 30	11.00
83.30	188.30

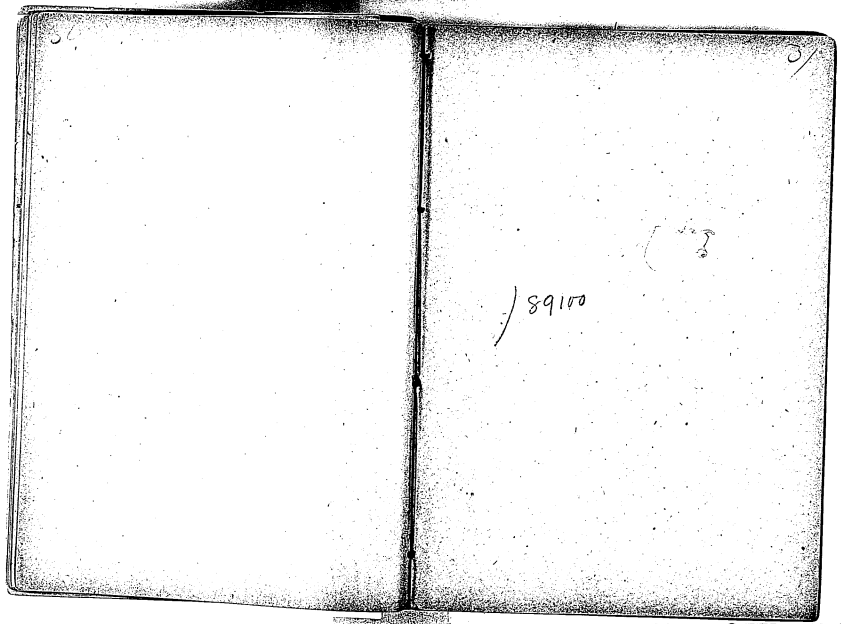
All hanging on two risers
risers at each pumps one nearest
Sandown

Rec. 182

Commenced Jan. 14. 1880
burning at 10.00 P.M.
Broke after burning 12 hours

1.38





Francis Cornesh mineralogist really

225 | 521664 | 2318
450
716
675
416
225
191

2318
12
4636
2318

2318
13
6954
2316
3013
2318
695

2318
12
27816
23180
3247

2318
16
37088
2318
34770

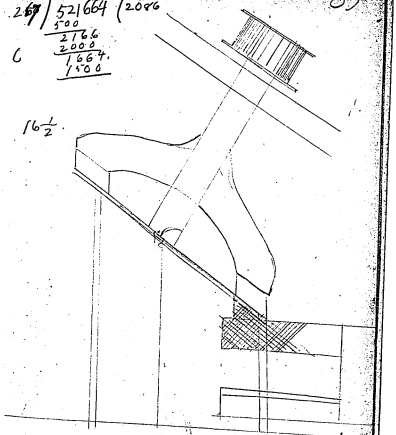
100
104
416
104
104
1664
416

474424
47424
47
4216

267 | 521664 | 2086
500
2166
2000
1664
1500

6

16 1/2



84 85

3 5

252. 253

85

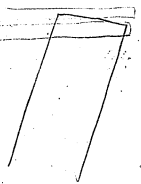
17 75. 53.

111 111 111 111 111 12321

2

262 216 12321 441 9264 484 2304 5421271

3416.



75 15 40 20 150 45 3 198

162 dif Lamia

262 Rio — 204 ohm

260 / 521664 (200

5 20

16

260 2 rms 5 20 000

304 / 542124. (1454

304

1386

1216

1692

1520

1724

11

28,

88 / 264 87 / 261.

330.

262

115-
115-
575-
115-
115-
13223-
44
5-2900
52900
381900

389 / 581900. (15-
383
1489
1915-
40

165-

310.

389 / 1490 (3
1167
323.

3

20

4

389 / 581900 (1490
389
1927
1556
3730

8

1470
22
2940
2940
32340.

1490 (20
9800

1490 (24
160

42

22.

88
3
264

88
88
704
704
7744
44
30276
302760 | 38
333
258
750
86

320. Lampo. 135 Rio

320. 86 ohms

86 | 343060 | 3989
258
850
774
766
688
780
774
6

3988 | 398
5
31904

64

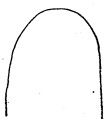
181
181
181

181.

1448
181
32764

31044
31044
144184

700 | 144.1484 | 2058
1400
414.8.
3500
6484.
5600



Caveat.

drawplate for fibre

soaked in standard solution sugar dried and cut. Alcoholic Solution with slight amount H_2O to render it more Soluable

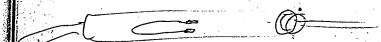
sugared ends continuation several loose fibres

separate fibre sugared Ends or sugared Ends + Silk sugar on

56

57

burner made of a great number of fibres held together with sugar – ‘extra fibre at ends also held by sugar,
or any carbonizable ~~fibre~~ Viscose sugar –

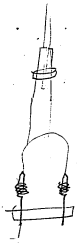


passing vapors of Hydrocarbons or carbonizable gases through that tube to build up by deposit,

An extra piece at X
+all sugared

Clamp

clamp for round carbons.



split wire taper outside to Hold Carbon ring tighter.

Wood cut on spiral, sugared on platina & wood.

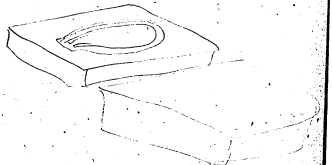
Rounded clamp

x peen hinge Carbon to heat clamps draw away

Nickel stamps.

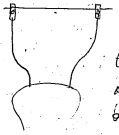
platinum Iridium with Iridosmium
Let on where Carbon Comes in Contact
also gold - Silver, Chromium
etc etc -

platinum Iridium screw - Hole through Carbon

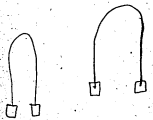


No tissue left at base of
Stupe,

blowing bulbs through Cotton
plaited or braided fibre,
Sugared thread,



Bias of clamps towards each other keep from breaking



paper Ends Sugared

clamp

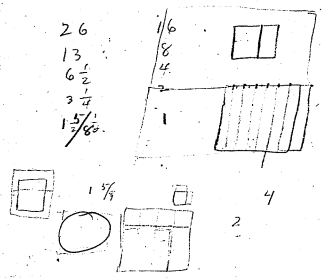
24 —

9

216

28.8 cm

24 —



Recd pg 131 Caveat Book 3
Mott

The object of the invention is to obtain light by the means known of Electric Carbonating matter.

The invention consists in various methods of manufacturing the lamp

I have found that when paper is to be used that it should be specially manufactured ~~and the fine cotton rags well boiled~~ so as to obtain pure Carbonizable fibre without dyeing and other foreign materials. Ordinary Brown Board contains Resin & other impediments rendering it non porous

to inks, this rosin carbonizes and as well as the fibers, and being in some cases of paper in greater or lesser quantity makes it very difficult to obtain incandescent Conductors of the same degree of Conductivity when subjected to the same Carbonizing processes, To obviate this I obtain the paper free from such matters and after Cutting the pieces of paper to make the Conductor in a larger form than the final Cutting I ~~coat~~ boil them in a Solution of Sugar in Alcohol or Alcohol & water or in a

Water Solution of sugar. The
strengths of these solutions must
be such that the required
resistance is obtained if a
low resistance is required a
thick solution of sugar should
be used and if a
high resistance the strength
of the solution must be
diminished. The horseshoe
form of burner which I have
shown in application
has the electrical ends which
serve to make good contact

with the clamps, & now cut out another piece or 2 pieces of a shape exactly like these thickened Ends. I place one on each rod maintaining them slightly with a syrupy Solution of Sugar, this seems to hold them in their position and when Carbonized the sugar Carbonizes as well and thus makes a solid piece which allows of Getting Clamping, & also has succeeded in plating these Ends with Copper Nickel & other metals, which serves to make Excellent Contact between the clamps and the Ends, & effect the

deposit by hanging the loop of
upon a wire connected to
connected to one pole of a battery & allow
the Ends of the loop to dip
in the plating Solution the
proper distance, the Jar
containing the plating Solution
being in contact with the other
pole of the battery.

In using long fibres such as Manilla
hemp & other fibres of the Hemp
family I also plate the Ends
very thickly and afterward drill
holes in the metal deposited
by electric deposition tap the
same & put in a short length of
Platina wire

These ends are secured to the platinum wires passing through the glass by a collar or clamp.

I makes lamps connecting several fibres each spread out but all coming to a common clamp, but in this case the aggregate radiating surface of all the fibres does not exceed that of a single paper horseshoe conductor.

I also bunch all these fibres together & pass the aggregated filament through a solution of sugar to hold them together

on single & even on an aggregation of distinct fibres & secure their Ends to a piece of Carboyable wood such as lignum vitae, box wood, Cocoanut shell, Bast fibre, by drilling a small hole in the wood & drawing the fibre through this hole & putting a slight amount of strain on the wood the whole is Carbonized & gives a good thickened End for clamping ~~the~~ a short piece of platina wire Being placed in one End of the wood & put in the mould when the fibre is Carbonized the wood shrinking

serves to clamp itself upon the platina with great force
as these clamps of carbon contain
a large quantity of gas which
comes out very slowly in the
Vacuum; It is best to employ
clamps of Carbon which have
been Carbonized and subjected
to high incandescence in
Vacuo to free it from air. Small
pieces can then be used with
fibres for ends, a very small
quantity of sugar carbonized
to hold the fibre to the clamp
in the act of Carbonizing the

Paper Loose shoes or
burners made of fibre.
may be (after Carburetted) placed
in Combustion tubes of platina
wire, and a hydrocarbon
Vapour passed through the
tube by the aid of a Bunsen
water vacuum pump.
the Hydrocarbon being decomposed
a very hard Carbonic
deposited upon the shaped
Conductor

The most perfect fibre for
Carbonization and use for light
by incandescence or for arc purposes is the fibrous
grass from south america called
Monkey Bast fibre, Each
blade of grass which averages normally 8 inches
~~in length~~ is composed of a great
number of fibres and the whole
cemented together with a
natural resin which serves
to carbonize & Crack all the
other fibre together, making
a nearly homogenious filament.
These ~~fibre~~ blades of grass
~~grow~~ are of various sizes

from 1/16 of an inch in diameter
to 5/1000 of an inch, they are
slightly tapered hence, I make a
cutting die, through which I
pull the fibre. The edges of the
die serve to shave off the
extra width of the thickened
end, another plan is to
use a revolving cutter, the
cutter revolving and is
passed along the fibre.
These fibres when small may
be put between paper and bruised and
squared & then carbonized.

or, gonoid of platinum Iridium
wire, may have a hole drilled in
the end about the size of the fibre
after Carburizing the wire is split
to the bottom of the hole or
lower, the fibre is placed in the
hole & the ends of the
wire is made slightly taper
a ring may be placed over it
thus clamping the fibre very
tightly

In Carburizing mounted wire
have sometimes dispensed
with the tissue paper between
Ends of the paper shoes or
fibre shoes with the weight

on top and metal ~~ad~~ ~~Cadmium~~ made a small indent into the nickel plate having a depth a little greater than the thickness of the paper over the smaller nickel plate is placed if a paper ~~tomorrow~~ is placed in the recess of the top plate put on it lays in a very thin chamber, but is free to contract. the two plates are placed in the nickel box and then

passed through the Carbonizing
process, the Shot will, being free
from restraint, contract in
a somewhat irregular shape
but it will ~~be~~ have less
flaws and will stand a
higher incandescence,
As platina combines to a certain
extent with heated Carbon
I put into the ends of my clamps
~~where the platina~~ thin plates of
Iridosmine, which does not
to the same extent combine
with Carbon, Gold, Chromium

manganeese chromium silver
+many other metals may be
substituted for the Iridosmin
but whether they will last for
long periods of time I am
now ascertaining.

I sometimes roughen the surface
of my platinoid clamps so as
to insure better contact, I also
instead of placing the
tightening screw some distance
from where the Carbon is
clamped. Cut a hole in the
threaded part of the shoe
before carbonization + then

place the shoe in the clamp & put the tightening screw through the hole

I ~~another~~ have wound a small spiral which forms a sort of a Cup and screwed one of these spirals to each of the platinum wires which is to be in the glass, in the Cup, I force the rounded Carborized wooden Ends of the fibres.

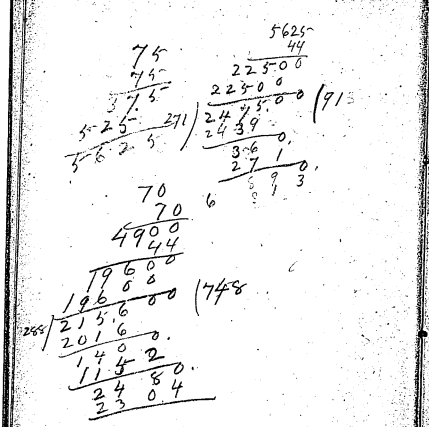
I distributing both the power and light & when there is a difference of price to be charged for Electricity when used for light or power, I place a double

meter in the ~~[illegible]~~ house of the
consumer and connect the leading
wires to the light ~~to~~ on meter. &
Extra leading wires to the 3
magnetic motors & and the
meter,
As the motors will for different
purposes be required to run
fast or slow, I provide each
with a governor which when
the speed increases above a
certain rate opens the circuit
& disconnects the motor
from the mains wires.

and as it falls in speed
closes the circuit again, as it
would be entirely impracticable
to use an ordinary one point
circuit opening & closing
magnetic governor owing
to the great spark due to the
Extra Current of the induction
bobbin & field magnet & use
several points & springs so
arranged that the circuit
is opened simultaneously
in several places & thus
so reduces it on any one

joints to practically obliterate
it as far as any appreciable distortion
of the contact faints are
concerned,
It is obvious that the governor
may be run on the main
shaft of the motor or
separately motor driving governor
it by gear wheels or worms & wheels
or belt connected to the main
shaft. ~~It would be better to~~
~~use a centrifugal pump~~
There is a deficiency in the slow
carbonization of organic filaments

See p 79 105



45 volts	R 365	—	244 ft lbs	$\frac{1}{10}$ candle
50 "	R 327	—	336 —	" "
55 "	R 312	—	426.	$\frac{1}{4}$ "
60	R 306	—	517	1 candle
65	R 292	—	636 —	2 candles
70 —	R 288		748	4 "
75	271.		913	6
80	—		—	8

95

200 / 440 ohms

1670.

45 Volts.	89.100.	R. 331
50	110.000	321
55	133.100.	315
60	158.400	313
65	185.900	306
70	215.600	
75	247.500	
80	281.600.	
85	317.900.	
90	356.400.	
95	397.100	
100	440.000.	

100 ohm change

1/10 candle

no change

3/4 candle

1 1/2 candle.

as then Hydrocarbons of are
formed before Carburation and
these Hydrocarbons are then
afterwards enclosed in Carbon
and are only driven off by
the highest measurable and
after a long period of time
to obtain a more rapid Carburation
& take a large platinum dish in
wire bent in the form
of a hinge-shoe from a groove
in the wire two or three
times the size of the fabric
which is to be fixed in it
after this is done & put

in a piece of the
platinum Iridium which serves
to cover the slot in which
the fibre is laid, the Ends
of the horse shoe are secured
to circuit clamps & the
whole arrangement is
placed in Vacuo, the wire
is slightly heated to drive
off the water vapor that
brought and slowly to incandescence
to effect the Carbonization
Carbon may be substituted
for the platinum Iridium
Even Vulcanite substitutes
may be carbonized in this

Improvements in the art of [illegible] and ~~rapid~~ duplicating Power of Letters &c by Electricity

These grooves, such as engraving which must be made use of in these papers to prevent the slipping of the platinum stylus,

Menlo Park—

Lamp on jump June 25

Paper New batteries

6250
6250
6290
6290
9850
34930

49 = D

112

Slightly red
80 Δ

At 4000

1½ candles

3 candle

6250
6290
6290
245 = Δ

120

1.9699
1.9899
1.6464
.0264
.7959
2.4085

3.5926

256 pt lbs. per candle

4100 pt. lbs.

Test 1 Paper Lamps

16 candles fore
door vacuum

6250

280 = W
93.3

6250
6290
6290

18836
94.15 ohms

1-5

1.9685
1.9685
1.6464
8.0329
8.7696
2.3859

3.6163

242 ft lbs for candles

4130 ft lbs total

1-55

6050
6290
6290
18630
9315

1-55

17 candles

3)279 = D
93

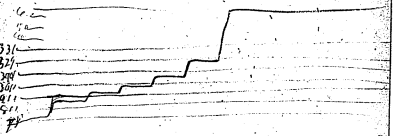
5970
6290
6290
18550
927

5970

1-56

5850

278 = D


C
"
"
331
329
349
341
611
77

120

1.9586
1.9586
1.6464
8.0324
8)7447
2.3778

3.6039

14

228 ft. lbs per candle

4010 ft lbs

Regular Paper 4 9/21

278 = D
17 candles

5700 Ohms
6290
6290
18280
9140 Ohms

2-2

5600
6290
6290
18,180
9090

276R = D
2732

(274
91.3

2-3

18 candles

122

1.9605
1.9605
1.6464
8.0429
3.6103
8.7212
2.3315

4080

214 ft Mc Pherson and

1st Test A

123

276.5 = D

5600
6290
6290

90.4

2-6 276 R
272 L

274
91.3

2-7 19 Cadillacs

5550
6290
6280
18130

90.65

2-8 272 L
275 R
274 R

12Y

1.9557
1.9557
1.6464
90.2 8.0448
3.6026
1.2900
2.3126

4000 ft lbs.

205 ft lbs. per candle

271
90.3

1.9557
1.9557
1.6464
90.1 8.0453
3.6031
21 candles 1.3222
2.2809

4040

191 ft lbs per candle

1st Test A. 1/25

2-10

5520
6290
6290

274R = D

2-13 19.5 candles

271R D
903

5470
6290
6290
18050 90.25

2-14 272R = D
271R = D

2-17 21 candles

15 ½ candles.
16.
16 ½.
17.
16 ½.
16 ¾.
16 ¾.
15 ½.
16 ½.
17.
17 ½.
17 ½.
16 ¾.
18.
17 ¼.
17 ½.
18 ½.

19. candles
19 ½. "
19 ½.
18 ½.
19.
18 ½.
18 ¾.
18
18
18 ½.
19.
19 ¼.
20
19 ½.
20 ¼.
20 ¼.
21.

1st test June 25 & 27

20 candles
21. "
2.18 ½ 272. Right.
" 20 c. candles
2.19. 5470. Ohms.
" 6290 "
" 6290. "
2.19 ½ 271. Left.
" 21 ½. candles
2.20 ½ 272. Right.
" 21. candles.
2.21. 5450 Ohms.
" 12580. "
2.22 269. Left.
" 21. candles.
2.23. 65. Right. 20 cells
" 64 ½. Left.

128

90 ~~1.9542~~
1.9542
Com 90 1.6464
3.6006
1.3247
2.2759

Beginning
94.1 Ohms 16 candles

End
90 Ohms 21.4 candles

1st Seat A

129

2.24. 21.4 candles.

2.24½ 270. Left.

" 5420 Ohms

" 12,580. " 90

18000.

" 21.4 candles

2.15½ 272. left.

" 21.4 candles

Short circuit Machine
2.M.F Change

2.29. 16. "

" 260. left.

2.30. 16. candles.

130

B 15

1st trial June 25 '15

2,31. 5650. ohms
" 12,580. "
" 260. Right.
" 16.2 candles
2,32. 16. candles.
" 258. left.
2,0½. 16.2. candles
" 260. Right.
" 16.2. candles

1st Test — B

2.33.	5670.	Ohms,
"	12,500.	"
	16.	Candles,
"	260.	Left.
2.34	262.	Right.
"	16.	candles
2.34½	16.	"
2.35.	260.	2,
"	5650.	Ohms,
"	12,500.	"
"	17.	candles

1st Test B

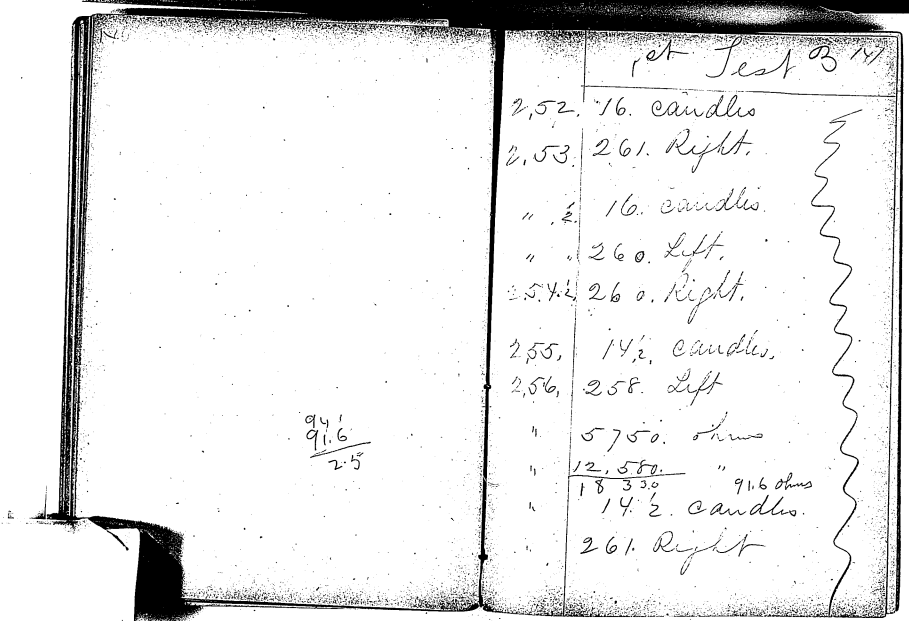
2.36.	262.	Right.
	5670.	ohms
	12,580.	"
"	65.	Left.
" ½	16.	candles.
2.37.	66.	Right.
" ½	15½.	candles.
2.38½	262.	Right.
2.39.	15½.	candles.
" ½	259.	Left.

1st Test 83

2.40	261. Right.
"	15. ½. candles,
2.42	15. ½. "
"	259. Left.
2.43	57.00. ohms
"	12 580. "
"	262. Right.
2.45.	Moved bar about 1.½. inches
	toward lamp.
"	Vacuum quite poor.
2.46.	260. Left.

1st Test Q 187

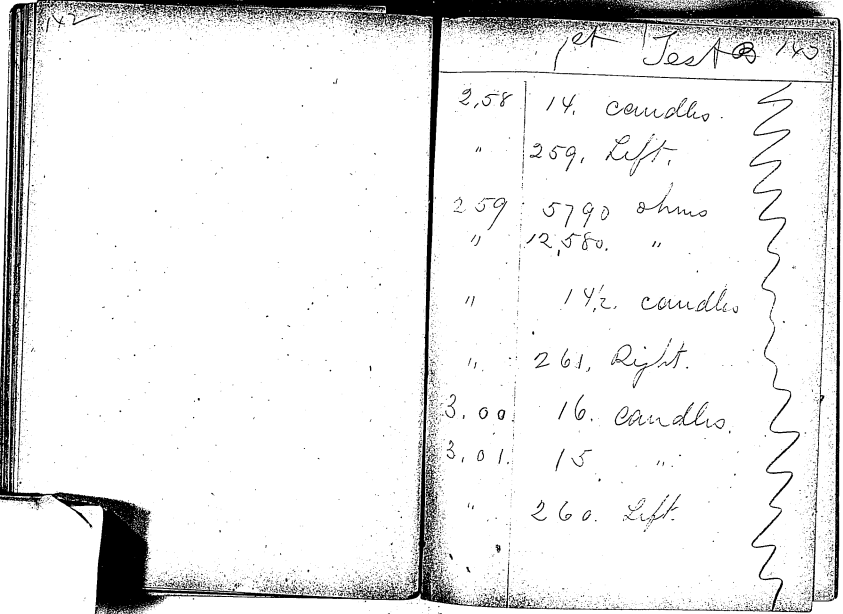
2,47. 261. Right.
" ½ 18. candles
2,49. 5750. Ohms.
12580.
" 17. candles
" 260 Left.
" ½ 16. Candles.
" ¾ 262. Right.
2,51. 16. Candles.
2,52. 259. Left.



1st Test B.W.

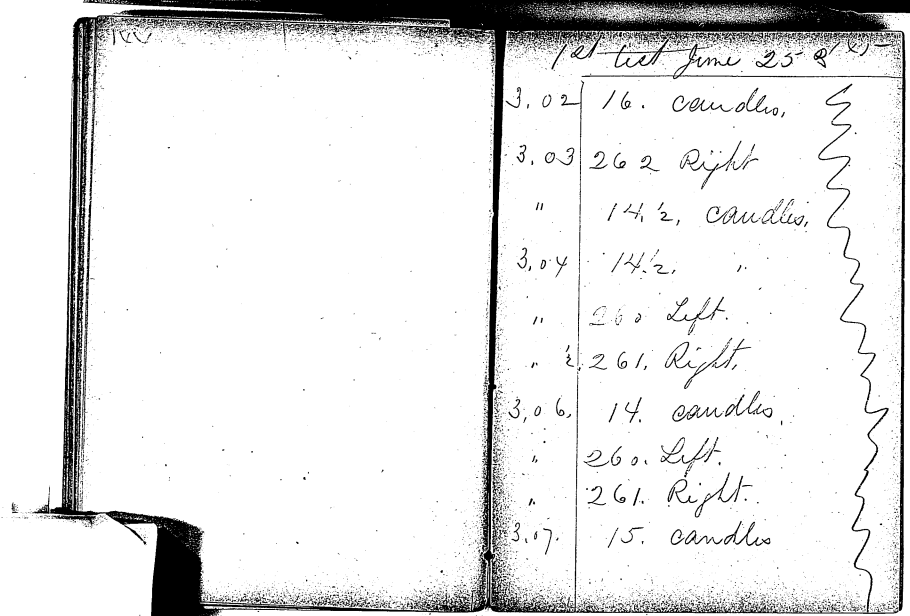
2,52. 16. candles
2,53. 261. Right.
" 16. candles.
" 260. Left.
2,54. 260. Right.
2,55. 14½. candles.
2,56. 258. Left
" 5750. ohms
" 12,580. "
18 33.0 91.6 ohms
" 14.2. candles.
" 261. Right

94.1
91.6
2.5



Jet Test @ 10

2,58	14. candles.
"	259, Left.
259	5790 ohms
"	12,580. "
"	14½. candles
"	261, Right.
3,00	16. candles.
3,01	15 "
"	260. Left



1st test June 25 8 P.M.

3.02	16. candles,
3.03	262 Right
"	14½, candles,
3.04	14½, "
"	260 Left.
" ½	261, Right,
3.06.	14. candles.
"	260. Left.
"	261. Right.
3.07.	15. candles

146

End of 1st test June 25

3.07 1/2	260. Left.
3.08.	261. Right.
" 1/2	13 1/2. candles.
3.09.	14 1/2. "
" 1/2	260. Left.
3.10 1/2	261. Right.
3.11.	13 1/2. candles.
3.12.	13 1/4. "
"	258. Left.
3.13.	260. Right.
	13 1/2. candles

148 Paper Camp Woodside

1.9699
1.9699
1.6464
8.6227
3.6081 9 — 4060 ft lbs
15.5 1.1903 3
2.4186 — 262 ft lbs for candle

2d test June 25. 09

3,50. 18. candles
" 288. Lift.
" 6200. ohms
Just in tube.

3 51 15.2 candles
" 6400 ohms
6290
6290
18980 — 94.9 Ohms
" 280. Lift
93.3 Volts
" ½ 282. Right.
" ½ 16 candles
3 52 6650.
Inch above tube
6650
6290
6290
19230 — 96.15 Ohms

150

1.9713
1.9713
1.6464
8.0173

96.15 | 5.5890

3.6063 — 4040 ft lbs.

16 | 1.2041

2.4022 — 252 ft lbs. for candles

5.5890
1.9759
3.6131 — 4100

19 | 1.2788

2.3343 — 216 ft lbs for candles

2°. bet June 25.

353 — 280 L

" — 282 R — 281 / 93.6

354 — 19. candles

" — 2.3 in above.

" — 19. candles

" — 6350. ohms — 6350 / 6290 / 6290 / 18930 / 94.6

" — 280. L.

" ½ — 65. R. 20 cells

355 — 19½. candles

5.5890
1.9782
3.6108 — 4080 ft. lbs.
19.5 1.2900
2.3208 — 209 ft. lbs. per candle

2d. test. June 25th 99

3.55. 4½ in above tube.
" 64. Left. 20. cells.
" 19½. candles
" 6450. ohms,
62 90
62 90
190 30
95 15
" 282. R. (284 93.6
" ½ 280. L
" " 19½. candles,
3.56. 4½. in above tube.
" ½ 20 candles
3.57. 6490. ohms

1.9850
1.9850
1.6464
8.0195
3.6309

4270 ft lbs.
213 H.lbs per candle

2d. test.

3.57. 279 Left
" ½ 20 candles.
" ¾ 281. Right
3.58. 4¾ in aber.
" ½ 20. candles.
3.59. 6550. ohms.
4.00. 20.¼ candles.
" ¼ 279. Left.
4.01. 281. R.
" ½ 20 candles
Vacu within one in of top.
4.02 20 candles

6550
6290
6290
19130
9566

2850
9606

End of 2d. test.

4.03.	20. candles.
"	280. Left
4.04.	281. Right.
"	20 candles.

1.9759
1.9759
1.6464
7.9957
3.5939
1.0600
2.5332

7450
6290
6290
20030
100.15 Ohms

3920 ft lbs

11.5

341.0

3.5939
1.7461
2.4478

14

281 ft. lbs for candle

3°. test. Boot fibre

1st time brought up

424½	284. Left.
"	11½ candles
"	¼ in in the bulb
425	747.0 ohms.
"	283. Right.
"	⅛. in. in bulb.
"	12½. candles
2.26.	14. "
"	282. Left.
"	1/16. in. in bulb.
"	745. ohms
" ½	14½. candles
"	283 Right.
"	7400. ohms.

946 Volts

427.	2. in in tube
"	15. ½. candles
"	282. Left.
" ½	16. candles
" "	3. in. in tube,
428.	283. Right.
"	16. ½ candles
" ½	7350. ohms.
429.	17. candles
"	4. in. in tube.
"	282 Left.
" ½	18 candles

2.30. 284. Right.
" 5.¼. in. in tube.
" ½ 18.½. candles.
" " 282. Left.
" ¾ 7400. ohms.
2.31. 19.¾. candles.
" 284. Right.
" ½ 4.¾. in. in tube
" 17.½. candles
" ¾ 7450. ohms.

page 158

3,5939
18 1.2555 3
2.3386 218 ft lbs. per candle

4.32½	18. candles
"	282. Left.
4.33.	19. candles
"	284 Right.
" ½	7450. ohms
4.34.	18. candles.
" ½	7480 ohms.
" 1.	282. Left.
" ¾	19. candles.
4.35.	65. Right. 129 candles.
	64. Left

166

1.9494
1.9494
1.6464
7.9887
3.5239
12 1.079 12
.4447

278 ft. Mrs per candle

End of 3d test. June 25/85

4.38.	19. Candles
" ½	19½ "
4.27.	19½ "
4.38.	283, Left.
" ½	285. Right.
4.40	Brought down to 18 Candles
"	265 Left.
"	7980 Candles.
" ½	267. Right.
	89

7980
6290
6290
21560
102.5
3145
134.25

1 — 44
2 — 176
3 — 396
4 — 704
5 — 1100
6 — 1584
7 — 2156
8 — 2816
9 — 3564
10 — 4400
11 — 5324
12 — 6336

25
44
100
100
1100

44
4
176

64
44
256

5-2 8256
2816

44
9
396

36
44
144
144
1584

16
44
64
64
704

49
44
196
196
2156

100

144
44
576
576
6336

11
11
11
121
44
484
484
5324

9
0

81
44
324
324
3564

4th. test. June 25th 1881.

456.	5½. candles. Bast fibre.
"	½. in. in bulb.
457.	275. Right.
"	6. candles.
"	⅜. in. in bulb.
"	10200. ohms.
501	274. Left.
"	8850. ohms. 2/1350
"	9. candles
"	2½. in. in tube.
" ½	276. Right.

92

1.9619
1.9619
1.6464
112.9 1.9469
3.51171 3290
9 1.9542
1.5629

305 ft. lbs per candle

Gas 4 ft. test. June 25th 1880.

5.02 273. Left. Burt.

5.04 4. in. in bore.

5.05 9. candles.

" 10,000.

" 12,580.

12580
112.9

" ½ 274. Left. 91.6 Volts

5.06 276. Right.

5.0½ 9. candles

10.100

Bast fibre Seat 5. June 26

~~Q-18~~	~~Started~~
	~~Transfer books~~
10 AM	Started
	20 cells
	65R
	65L
Q-14	6 candles
	7 Changed to start that 9 could not get a measurement ~~7~~ R.H.
	9'4
	1/4 inch in 12 candles

6300
6290
6290
6250
25130
125.6 Ohms

1.9474
1.9477
1.6464
7.9020
3.4436
½ 1.0792
2.9644 2770 231 ft. Mho for one side

5500 86.6
6290
6290
6250
24330
121.6
13.5

1.9375
1.9375
1.6764
7.9151
3.4365 2780
1.1303
2.3062 202 ft. Mho for one side

Sesh 5

265 R.
265 G
886
6300

260 Left
260 Right
5500

10,20 13½ Candles

1½ mi in tube

10,21 1 & 3/4 Candles
5200
2½ mi in tube

178

5200
18830
24030
120.15

14.7

183 ft lbs per candle

86.6

1.93785
1.9375
1.8884
7.9191
3.4305 sq
1.1673
2.2632

5000
6290
6290
6250
23830
189.15

261
87.3

2840
16.5
172

1.9410
1.7910
1.6464
7.9245
3.4529
1.2176
2.2354

4700
18830
23530
117.65

88.3

2910
17.5
166

1.9460
1.9460
1.6464
7.9296
3.4640
1.2430
2.2210

Test 5

179

10:23

260 G
260 R

14½ candles

16½ candles

5100
6290
6290
6250
3/21 in tube

20)23830 (119.15
6290
6290
6250
18830

10:28½

17½ candles

263 R
263 G

4700

1.1266
98.6

1.9474
1.9474
1.6464
117.4 7.9303
3.4715
2960 18 1.2553
164 2.2162
ft. Hefner candle

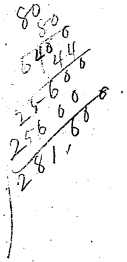
87.6 1.9425
1.9425
1.6464
117.25 7.9314
3.4628
2900 20.5 1.3198
2.5510
141 ft. Hefner candles

Test 5 June 26 '81

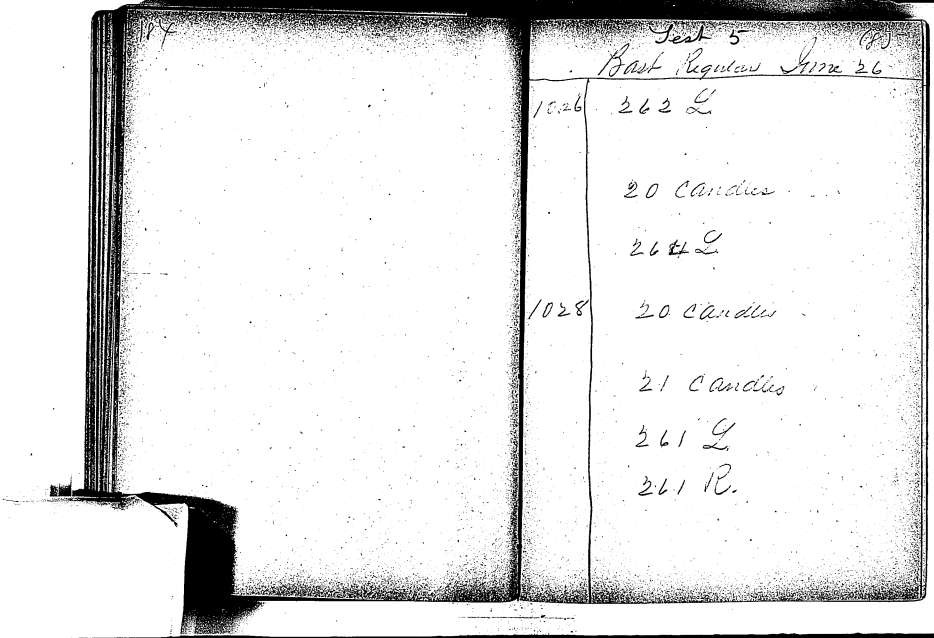
10.24 18 candles
26.6 L.
26.6 R.

10.25 20½ candles
4600

20½ candles
260 L.
260 R.



292 | 185900 | 636
1752
1076
876
1940
1752
188



Seat 5

East Pequeus June 26

10.26	262 L
	20 Candles
	264 L
1028	20 Candles
	21 Candles
	261 L
	261 R.

116

86.6 1.9375
1.9375
1.6464
116 7.9355
3.4569 2860

143 ft lbs per candle

Seat 5

Ann Sinn 26

20 candles

6400

261 L

10:32 19½ candles

260 L

260 R
86.6 Valves

4650

4600
6250
6290
6290
23290
116.

4500

Test 5 17

Beast Reguar June 26

0.34

19 Candles

260 G.

260 R.

4500

19½ candles

261 R.

261 G.

4500

2700
18530
2 / 21530
107.6 Ohms

295 / 98.3

19926
1.9926
1.6464
.9684
3.6000
44 1.0435
1.9565

90.5 ft. Ans.

Bart Leg Jan 26

10.36 295 - L.
44 Candles
2700
290 L.
290 R.

10.38 66½ inches on Bar.
293 L.
293 R.
2600

192

Test 5 193

Bast Rig. June 26

10.41 291 L.

291 R.

66½ inches

10.43 66¼ inches

291 L.

291 R

644 0

Seat 5 1915

Bank Reg. June 26

10,44 291 L.

291 R.

66 1/2 inches

290 L.

66 1/2 inches

293 R.

66 1/2 inches

293 L.

10,54 294 L.

66.5 = 48.5 candles

50.
66.5
13.5

1.8228
1.1303
.6925
2
1.3850

1.8195
14
.6730

24.2
2
48.5 candles

1.9912
1.9912
1.6464
7.9751
3.6039
2.6857
.9182

4100 ft. lbs

82.8 ft. lbs

Reg Boats June 26 19

2350

10.68

294 R.
98

6290
6290
6250
2350
21180
105.9

6430

3.6039 | 4100
67.3 ft lbs

198

Seat 6 Bael Filter Reg June 26 1880 77

2 test P. 111

2-21 Resist Cold 6290 x 12

65 R } 2.0 ales
65 L }

6250 x 2
6250
6290
6290
6290
6290
7000
2)44660 2
2233.

2233 ohms cold.

Specimen

5550
6290
6250
6250
243 #0

Ohms 121.7

3 | 260
833

1.9206
1.9206
1.6464
7.9149 5.4876

2520
5.5
460

3.4025
0.7404
2.6621

~~5550~~
6290
6290
6250
18830
5030
23860
1194

5.4876
2.0770
3.9106 2570
8 0 9031
7.5075 .321

Test 6 June 26. 08

2 — 5½ candles
260 Kaft

5-5-50

¼ in. in butt

8 candles
6-0-50
260 Ra

1259
86.3

118.9
2770 8.5
326

1.9360
1.9360
1.6464
7.9249
3.4433
0.9294
2.5139

8.6

2/3950
175

118.9
1.75
117.15
2800
9.5
294

1.9345
1.9345
1.6464
7.9314
3.4468
0.9777
2.4681

5.5154

5.5154
116.1
2820
11
257

2.0649
3.4505
0.0414
3.4091

Feet 6

8 1/2 @ cents

4950

9 1/2 C.

1/8 in in mile

2588 L.

4400

10 C.

11 C.

4400.

Feuth

1½ in in Cette

2-5-8 10.

4 200

205 12 d.

4 150

2-5-7

4000

3½ in in Cette

12 d

205

6290
6290
6290
4000
22830
1.14.15

85 1.9294
1.9294
1.6464
7.9448
3.4486

2790 12 1.0792

233 µM 2.3674

Test 6 Date 26.80

4000.
25-5-E.
12 E
25-5-R
3950

2 → 25-5-R.
4 in Nitric
12 E
3800
25-5-E.

6250
2290
6290
3250
22080
110.4

1.9294
1.9294
1.1464
7.9586
3.4638
4.5185
8.0547

3.4638
12.5 | 10969
2.3569
232 ft. lbs

Test 6
Rig Bar — June 26. P.M.

2,05 — 12½ c.
3250
2550 C

2,10 — 12½ c.
3250 Ohms

12¾ c.
2550 - 12
85
3150

3650
18830
22480 | 1254
1124 | 896

1.9274
1.9274
1.6466
7.9493
3.4505
1 1302
2.3202

2820
13.5

209 ft lbs per candle

Test 6
Reg Book June 26 C.M.

2.11
13 c-
4½ Cinn Lets
25-5- C.

13½
254
3650
13.2

2.12
254 C.
.15-C
3550
254 R.

212

3500

213

Test 6

Reg Bus Journal

2,14 14 1/2 C.

8450

2574 C.

14 C.

2574 C.

33500

2,15 2574

14 C.

18880
1100
19980
99.6

443000 5.16464
1.9980
3.6481
1.6435
2.0046

101 ft. lbs

Test 6 215

same lamp Sine 26.

4H Candles

1100

300 L.

66¼ inches =

800

2,20 300 R.

298 R.
298 L.

66¼ inches =

400

66¼ inches

297 L.

297 R.

214

6290
6290
6250
250
19080
95.4 Skins

Test 6 215

Boat - Reg at [illegible] Time 26 Min

250 26 Con.
295 G.
66½ [illegible]
250 26
294 R.

2.30 Scum off high line

218

6290
6290
6250
1000
19830
99.

No. Test 7 219

Reg Bast fibre June 26 PM

335- 2000 lb

8½ c.

1750

256 L.

12 Candles

1400

1000

17 Candles

6290
6290
6250
1000

220

24 candles

5500
6290
6290
18080
90.400 hrs

Tallow 83

1.9191
1.9191
1.6464
80438
3.5284 3370
24 1.3802
2.1482

140 ft. lbs for candle

221

Test 7

June 26

24 Candles
after this
5500
6290
6290

250 L.

24 candles

247 L.

66 3/4 inches

280 R.

4200

4100

222

6290
6280
2700
15280
76.4

68 1.8325
12 1.0792
.7533
2
1.5066

32
2
64
12
77

74.4 ft lbs

4 1.6464
8.1169
3.7633
5800 ft lbs
3.7633
1.8865
1.8768

Test 7 June 26

3.45 300 G
2800 lbs/in
68/12 inches
2700
2801

3-45 Broke

If 8 light of 16 candles

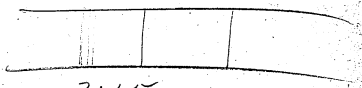
16 1.2041 per H.P.
8. 0.
128 candles per H.P.

4.5185
2.1072
2.4113

.257 ℔ Cos per candle
will give at 8 per H.P.

100 Ohms coil

6290
6290
800
26380
101.9



31.45

240
80

1.9031
1.9031
1.6464
7.9814
3.4340
6.5185
.0845

2720

12.2 per H. P.

3.4340
1.1139
2.3201

209 ft. lbs. per candles if 13 candles

240
13
~~16~~ candles side

6290
6290
8360
20860
104.4

Test 8

New carbon never brought up. Jan 28.

Lamp Bent filter

Regular 0".012 X 0".012

Two plates between clamps

11-25 20 cells 65 R.P.S.

11-8 4 1/2 candle

3 7/14 "

248 C.

6250.

6290

6290

8270

270

8000
6250
6290
12290
26830
13415

June 28

3,15 6½ Candles

8200
6250
6290
6290

248 R.

6½ Candles

248 L.

6½ Candles

8000

6½ Candles

232

230

June 28

290 L.

23 1/2 candles

5-25-0

310 L.

3,22 —

66 3/4 inches

25-00

310 L.

Sept 8 June 28

3.20

67 inches

2400

308 ℄

66 3/4 inches

67

309 ℄

67/4 inches

2100-
6 350
6 210

298
99.3

18,830
2500
21330
106.6

1.9969
1.9969
1.6464
7.9722
3.6824
1.6435
1.9689

93.1 ft. lbs per candle

June 28

32.8

308 L.
66¼
300 L.
2400
300 R

298 L.
2500

33 3

4100
11½ candles
245

1.9206
1.9206
1.6464
7.9435
13.4311
14 1.1461 ·2700
2.2850

192 ft. lbs. per candle

4.5185
3.4131
.0874

12 per H.P

June 28.

14 candles

3)250 C.
83.3
3950
6250
6290
6290
22780
1139

6½ candles

4950

·222 C.

270

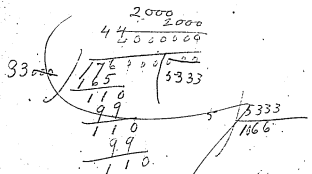
26 candles

3600
6250
6290
6290

June 28

67½ inches
298 L.
2600

3,40 66½ inches
2900
289 L.
289 R


2000
2000
44
33000
165
110
99
110
99
110
3333
166
56
330

1.9850
1.9850
1.6464
7.9647
3.5711
1.5345
2.0396

109 ft. Mag. Var.

4-15 Pump running until this time with lamps

290 L
46.6

3400 Ohms
6290
6290
6250
22230
1111.5

4-30 292 L

3700 Ohms

29 R

34 candles
Very high

246

1.9474
1.9474
1.6464
7.9261
3.4673
14 1 1 4 6 1
232.12

209 lbs. per candle

250

June 28

14 candles
3 | 266 L
88.6

4500 lbs
6250
6280
6280
23610
1185.05

Calorimeter Galvo.

~~Temp solution~~

Temp air 85.0

Soft bast fibre June 29. 80

~~1880~~ Count started

20 cells 65
6250
6250
11— 6290
6290 All the bars resistance
6290 cold.
6290

100 G.

Carbon does not slightly
improve

200 G

All the bars are 12,000 each

6296
6290 12,000 ohms
6290
6290
6250
6250

2.0315
2.0315
1.1464
.77122
3.4216 2640
13 1.1139
2.3077 207 ft. lbs. per candle

Coffee Basin June 29

11.10 [3238 Q.
1076
6290 7.570 ohms
6290 Stirred all the connections and found
6290 194. them good.
6250
6250
38870

11.12 3238 Coffee
3238 R.
6290
6290
6290
6250
6250 6950
6950

13 Candles

June 29 80

11.16 350 Ω

2 2½ candles

62 90
62 90
62 90
62 60
62 80

2700 ohms

350 Ω

350

1 Volt = 2 D

11.20 43 - 20 cells

250 Ω

62 90
62 90
62 90
62 80
62 40

3600 ohms

June 29

10.25 230 Left

17½ Candles

1128 18 Candles

232 L.

3700

240 L.

22 Candles

3200 ohms

6290
6290 — 12,580

12580
6290 — 18,870

18870
6290 — 25,080

25080
6290 — 31370
0

31370
6290 — 37,660

125 — 2.0969
2.0969
1.6664
7.7452
3.5854
29 — 1.4624
2.1230

132 ft. lbs. per candle

June 29

11,30

250 L

29 candles

6290
6290
6290
6290
2300
27380
136.9 Ohms

27380
6290
23090
135970
179.8 Ohms

258

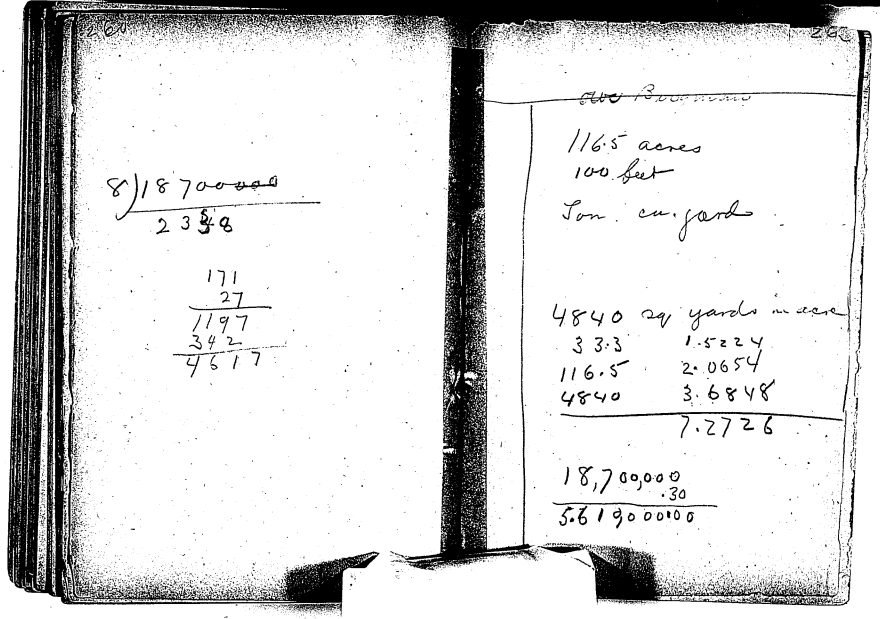
35 Candles

1400 Ohms

~~Very~~ Ohms

190 L No Glue

3½ candles



8)18700000
2338

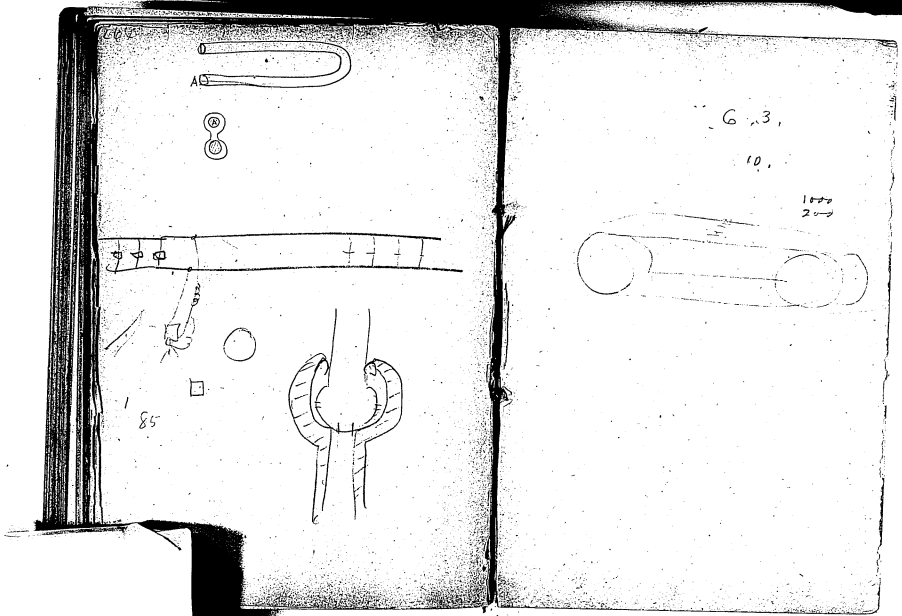
171
27
1197
342
4617

116.5 acres
100 feet
5 on. cu. yards

4840 sq yards in acre

33.3	1.5224
116.5	2.0654
4840	3.6848
	7.2726

18,700,000
.30
5.61 9000000


A
1
85
G. 3,
10,

Menlo Park Notebook #45 [N-79-04-09]

This notebook covers the period April-September 1879. Most of the entries are by Edison, Charles Batchelor, and Francis Upton. A few entries are by John Kruesi. Included are notes, calculations, and drawings of generators; calculations about electric power distribution; notes and drawings of the telephone; and notes by Upton on repairing lamp problems in the stateroom of the Jeannette, a ship being outfitted for an arctic expedition. The book contains 104 numbered pages followed by about 200 unnumbered pages.

Blank pages not filmed: 62-63, 66-67, 86-95, 98-104.

Missing page numbers: 21-22, 69-70.

No 45

LIBRARY OF THE

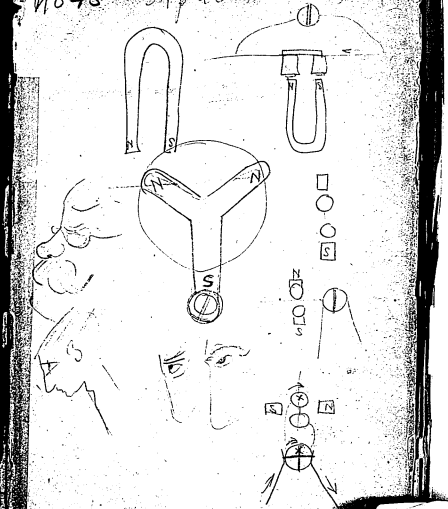
BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

GENERAL ELECTRIC.

_____, 189_

No 45 April 10 1879 Tag

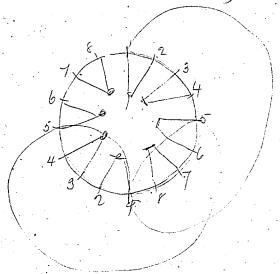


2

3 7/8 inches
1/4
17 4 4
3 7/4
3 6/4
3 4 2
1 1 1
1 4 5 2/4
3
4 3 5 6

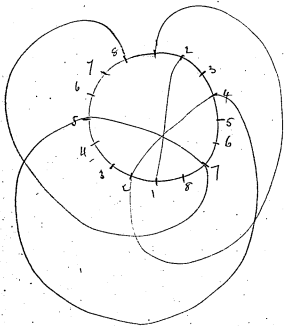
April 9 1894

Jute

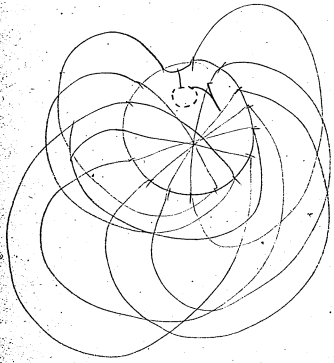


April 10 1879

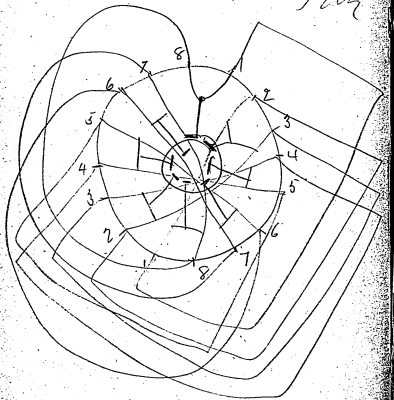
Tax



April 10 1874
TCR



April 9
1871
Fah

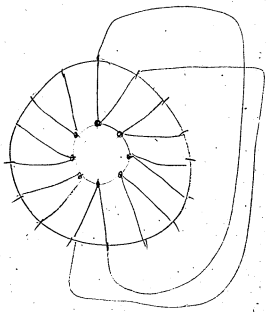


10

11.

April 9

1879 Tues



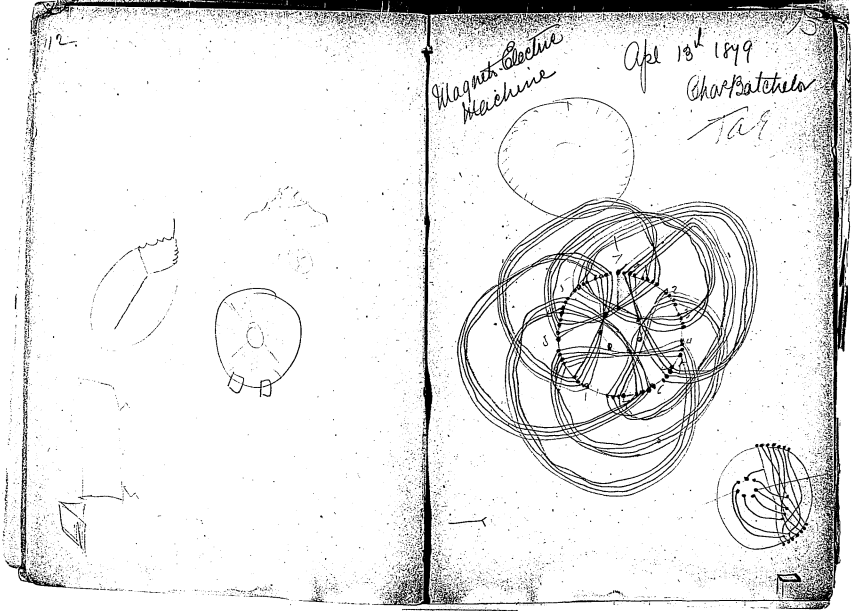
12.

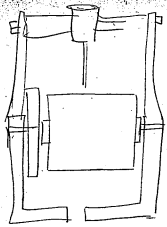
Magnet Electric Machine

April 13th 1849

Chas Batchelder

Tag

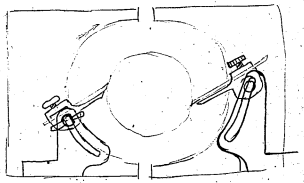


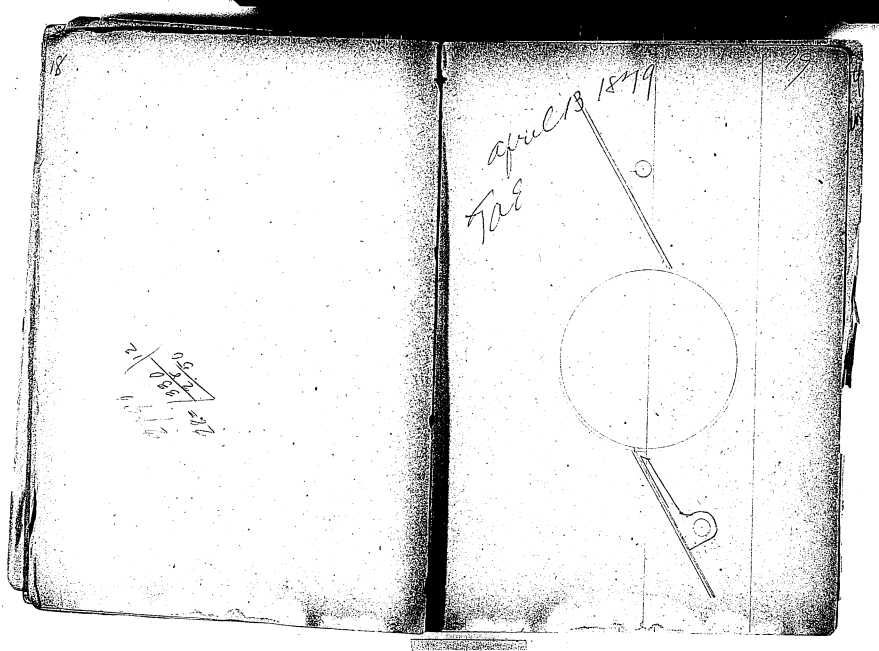


April 13
1874
TE

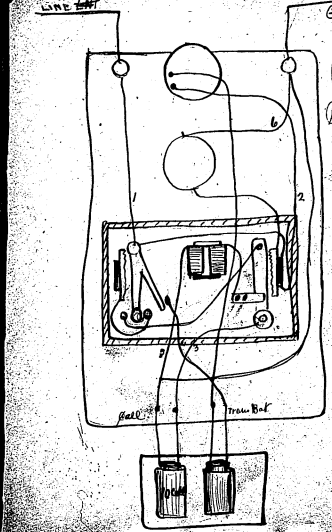
16

April 13 1874
J.A.S.




18
April 13 1879
Tool

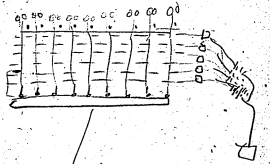
Connections for Bolam telephone



May 15 1906
Chas Batchelor
F. A. E.

May 13 1879

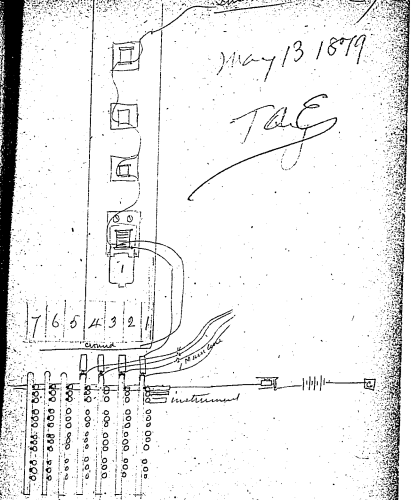
Jas



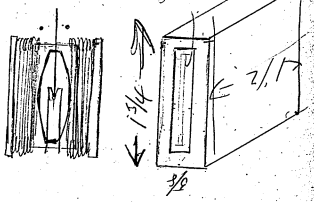
Instrument

May 13 1879

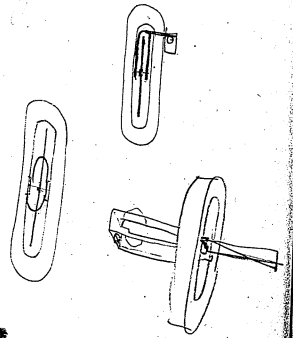
T. A. E.



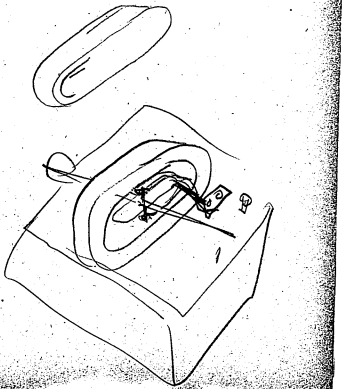
May 13 1844 Joe



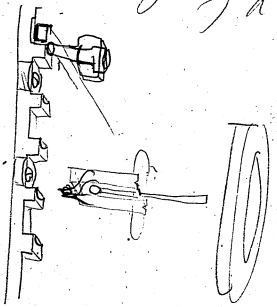
May 13 1879
TLE



May 13 1879
TLE

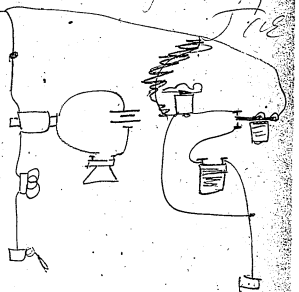


May 13 1879
T A E

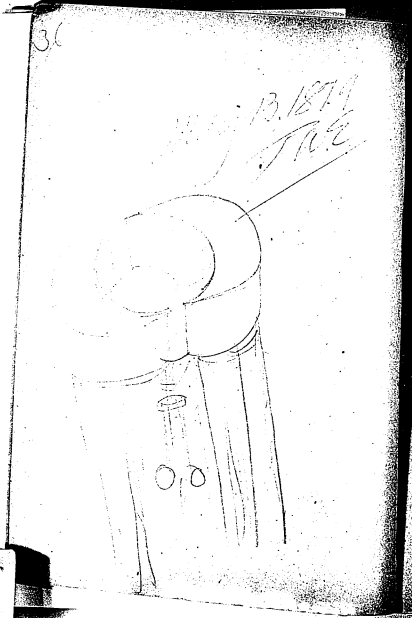


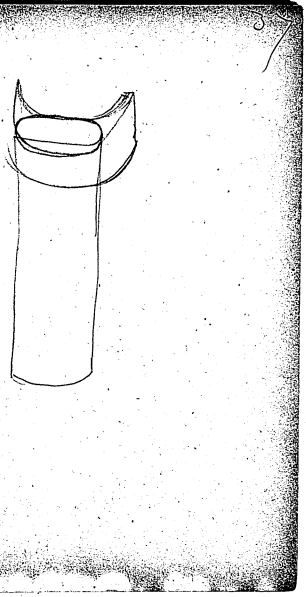
Telephone May 13 1874

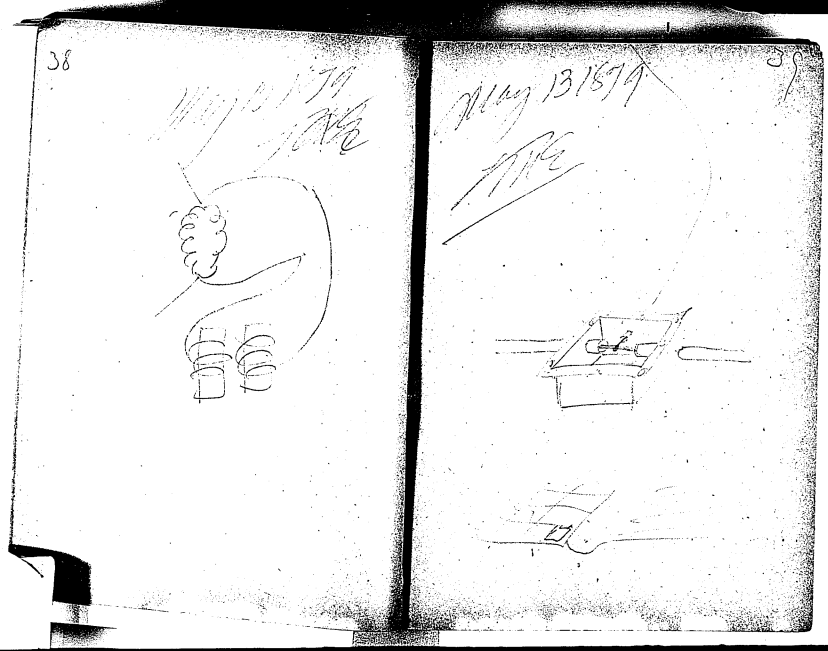
Line



Put other end like this


BATH
TUB





40

16
300
4800 60

$ 1200

4800 | 1200
28800

$ 1200.

240

1
240

240) 1.000 (.41
960
40
240
200

May 15-1871 Jr 41

4.1 Mills per

H.P. per hour

60 H.P. 16 Hours

per day 1 year

300 working days

300
32
9 | 268
30
15
180

42

6000 burners

4 feet burners

$1.60 per 1000 for

$\frac{1}{250}$ X $1.60 per hour

$\frac{1.60}{250}$ $ .25

.16

4

.0064

6.40

6.4 mills per hour

Power at 10 mills per hour

six lamps

each 1.66 mills per hour

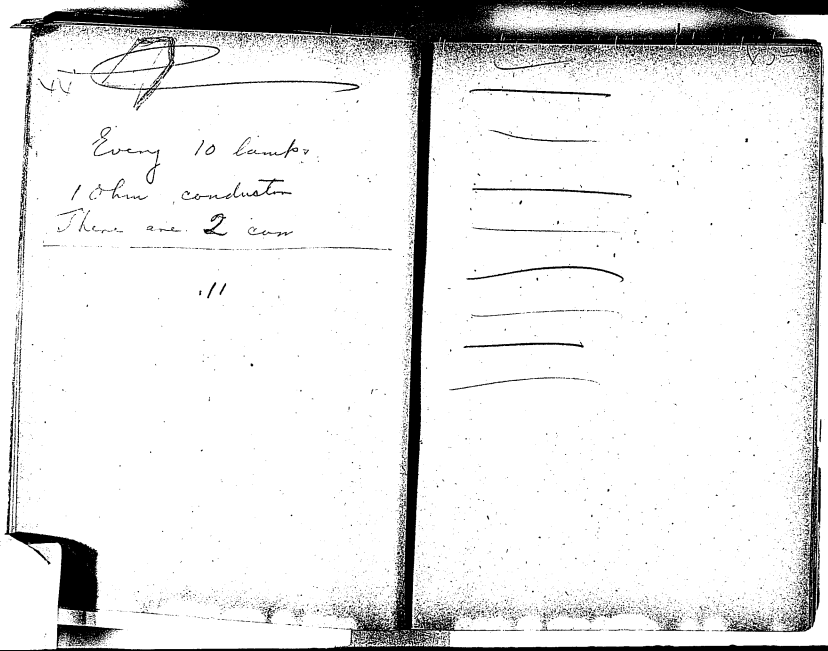
four burners

$33.000 per year

6000 lamps Parallel wire

10 Ohms. 10 ohms

$1.00 Interest the rest


Every 10 lamps
1 Ohm conduction
There are 2 cuts
11

4) 5280
1320

20) 2640
132

2.1206
2.1206
2.0969
2.3381

217 lbs
43

4) 8 2 1.6

Distance = x 2

=

48

$\frac{8.5}{17} = 8.$

12

8

9 10

$\begin{array}{r} 2.5 \\ 4.8 \\ \hline 20 \\ 40 \\ \hline 140 \\ 4 \\ 8 \\ \hline 12.5 \\ 4.3 \\ \hline 1 \end{array}$

1 4 6 9 16 25 36 49 64 81 100 121 144 169 196 225 256 289 324

$\begin{array}{r} 324 \\ 121 \\ \hline 203 \end{array}$

49

10

132.0
8
1056.0

28 | 2 8 n q .
105

2.0212
2.0212
2.0964
2.1398

128 lbs
32

Hours

$(a+1)(a+2)(a+3)(a+4)(a+5)$

52

217 lbs 1/4 mile

1000 feet

50 men on 1000 feet

20

2000 feet

of wire

~~1.6990~~

~~1.6990~~

50 | 2000

100

20 | 2000

100

2.

2.

2.0969

2.0969

125 lbs of wire

20 | 1960

98

1.9912

1.9912

2.0969

2.0793

? lbs of wire

120 lbs of wire

53

5K

20 / 1920
96

1.9823
1.9823
2.0969
2.0615

115 lbs

22 / 1888
94

1.9738
1.9738
2.0969
~~2.0245~~
2.0431

110 lbs

20 / 1848
92

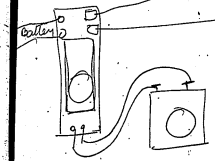
1.9638
1.9638
2.0969
2.0245

5J

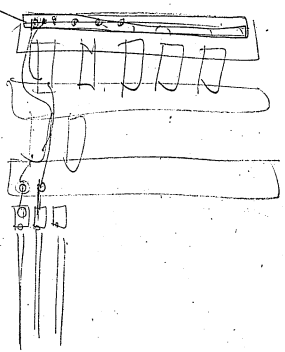
56

May 16 1879

Connection



Put a little glue to each



May 16 1879 Fri

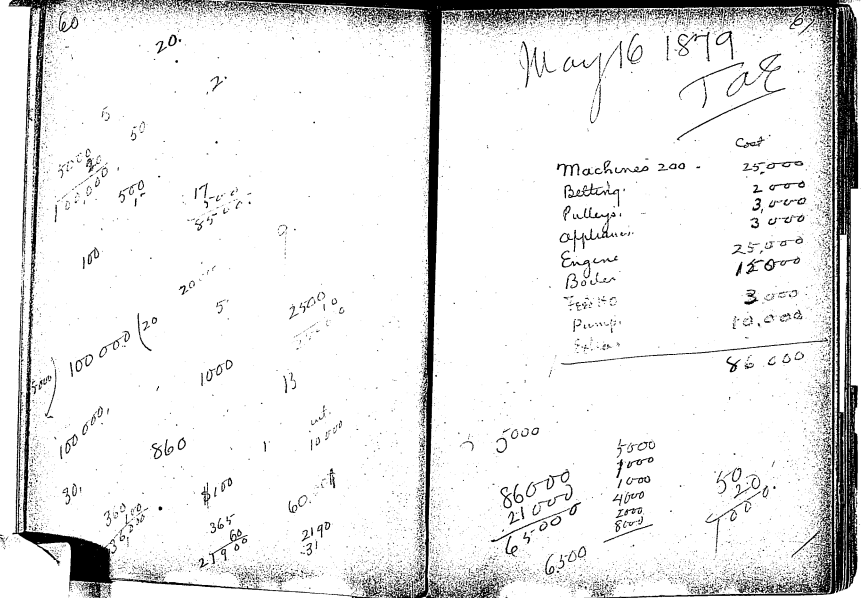
Have spring made for dear

$\frac{3}{32}$ wide

Have pattern for damper

See about rubber tubing for connections

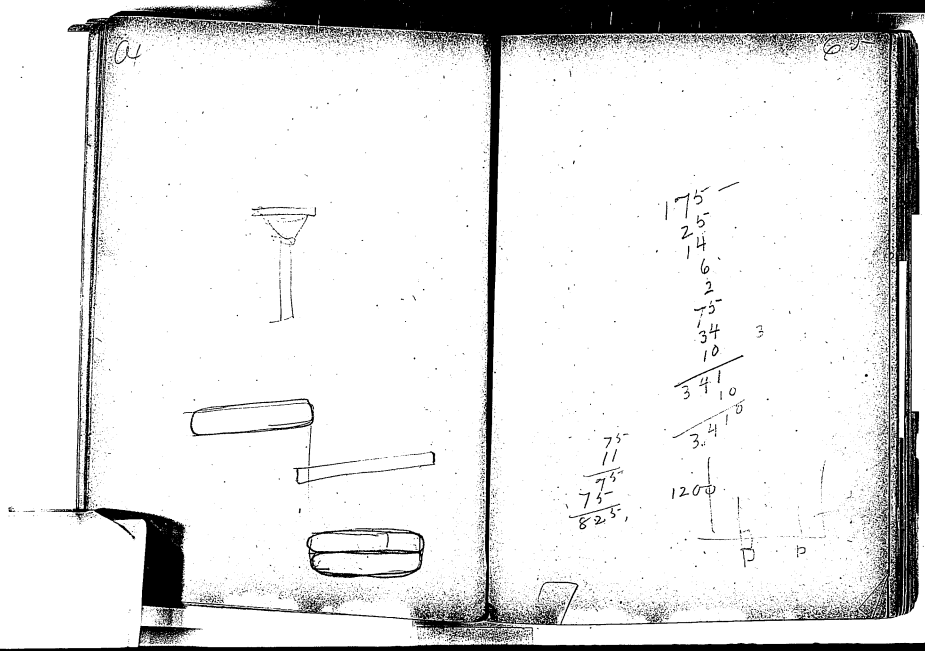
~~put in~~ 8/32 ~~set bolts~~ screws for damper

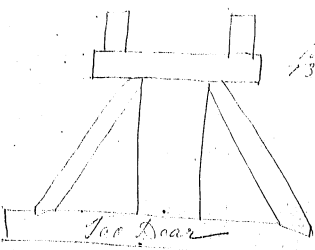


May 16 1879

Tax

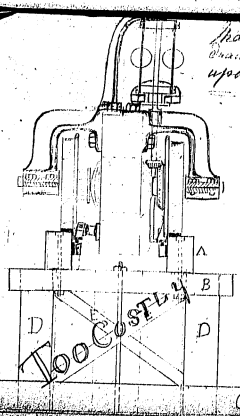
	Cost
Machines 200 -	25,000
Belting	2 000
Pulleys	3,000
appliances	3 000
Engine	25,000
Boiler	15000
Feed [illegible]	3,000
Pumps	10,000
Safes	
	86 000


175
25
14
6
2
75
34
10
341
341
75
11
75
825
120
P
P



1514.00

Machine of 1000 pounds draw upon a level 2.3 3/4 pounds upon a grade of 250 pr mile 1.74



May 16 1879

3460.00

12

A - 2100
B - 504
C -
E

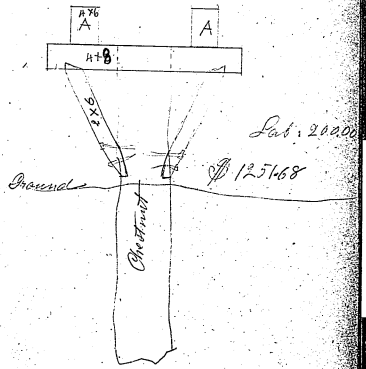
$5.00

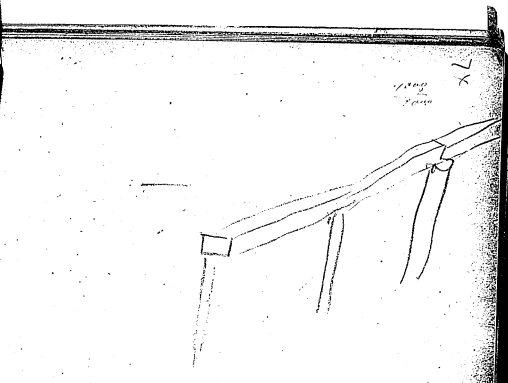
500
506
200
100
13.05

9
1 1.68

1 51

May 16 1879 Jas 30





300 tons 52.8 per mile — 16 miles

.2 X 1000 = 200
11.42 + 8 = 8.4242

2240
100 / 67200 = 672 / 1595.4 = 25
1344
2514
2240
274

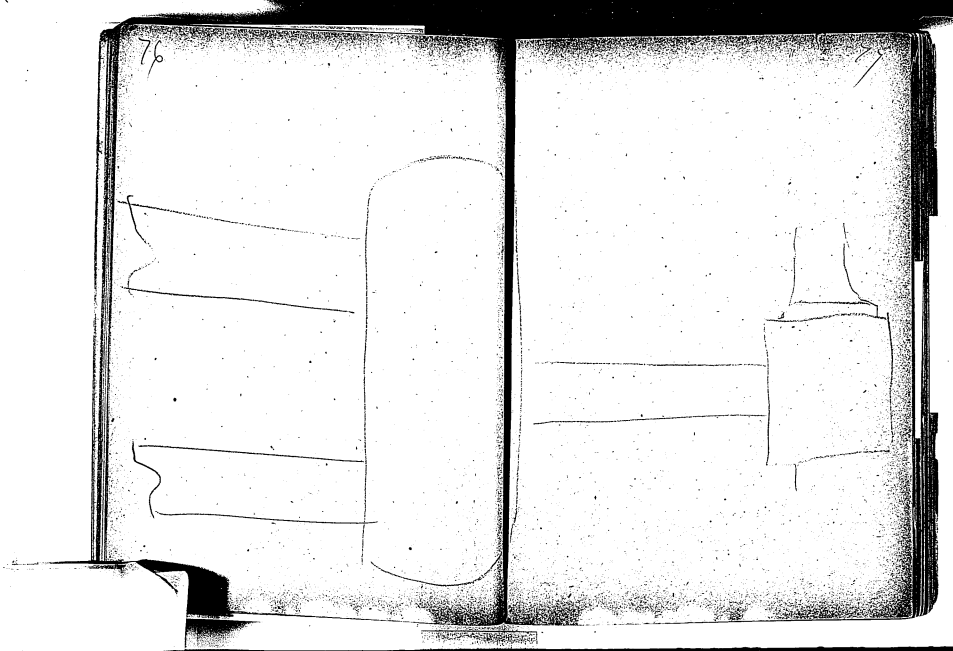
8.4242 / 200.0000 = 23.74
16848
31516 0
23276
62434 0
58469 0
3464 60

.2 X 1000 = 200
11.42 X 250 ÷ 8 = 114.35

1.74
11405 / 20000
11405
85050
79835
52150

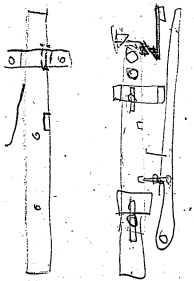
4242
250
1060500
114

1.5 5280 11.42
5280
5280
5280



May 16 1879

Jas

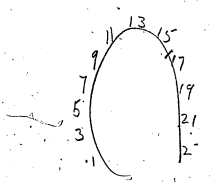


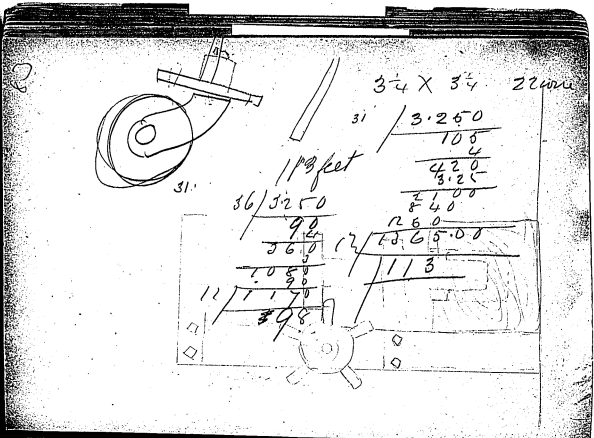
80

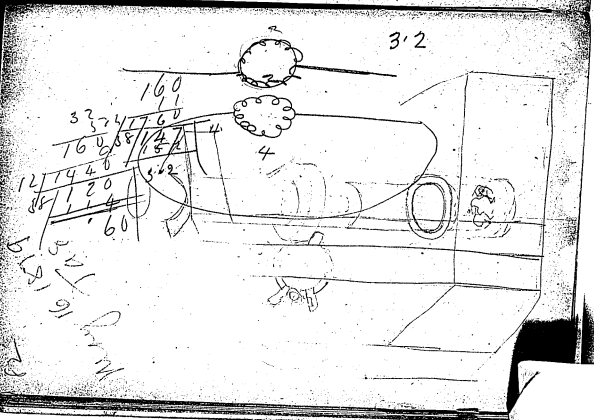
81

1
3
5
7
9
11
13
15
64

17
19
21
67

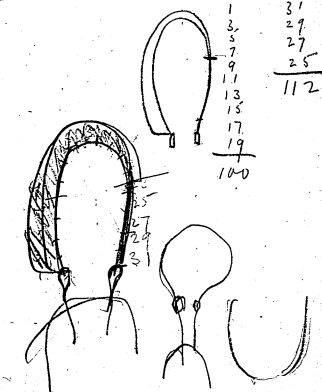


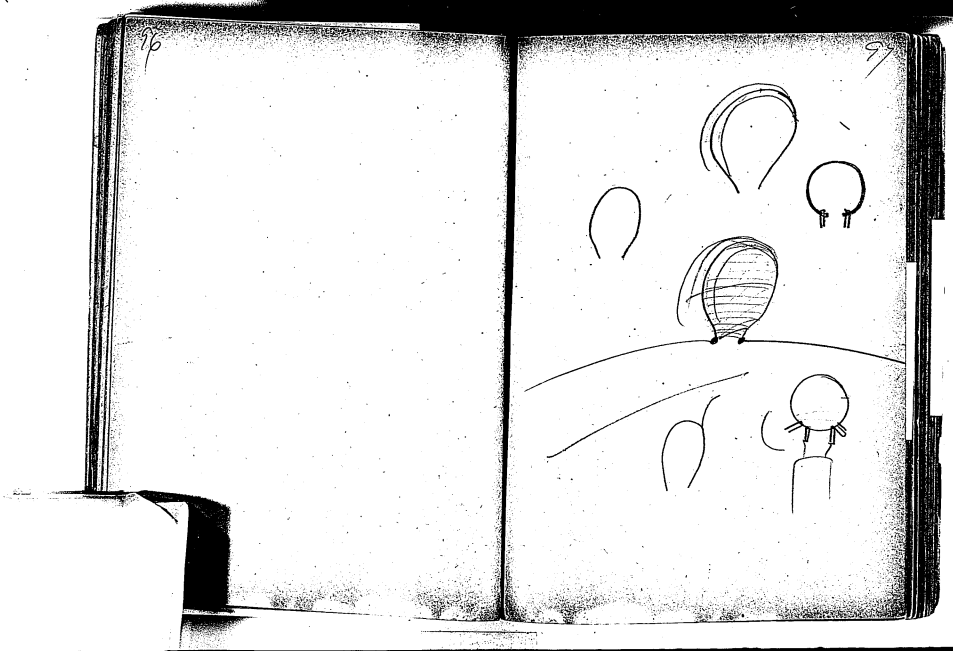

3¼ X 3¼ 22 cu
31
3.25
105
420
3.25
2100
840
260
5.65.00
113
31
1 lb feet
36
3.25
90
360
705
90
12
1170
98

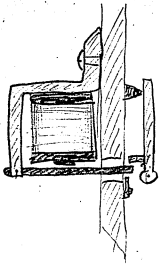

3.2
160
160
32
160
88
12
1440
120
144
60
4
4
5.12

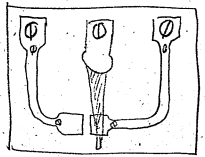
84

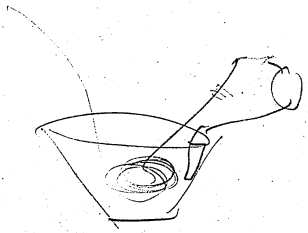
Regulator




96
97







Make 12 buttons.
Chalk + water same amount ($\frac{1}{2}$ H_2O)

No 1 2 grain Carb Soda dissolved in H_2O

2 ditto

3 2 grain Chl Codeine in H_2O

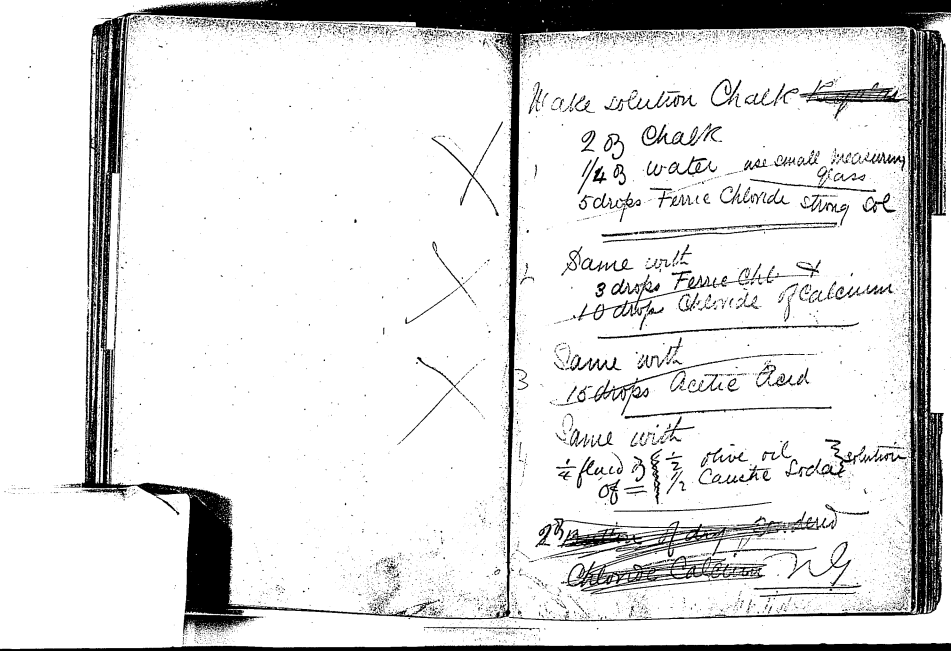
4 ditto

5 & 6. 2 grain Chl. Cal.

7 & 8 2 grain Chl Ammonium

9 & 10 2 grain Sulphate Potash

11 & 12 2 grain Nitrate Ammonium



Make solution Chalk ~~Emp~~

2 ℥ Chalk
1/4 ℔ water use small measuring glass
5 drops Ferric Chloride strong sol

Same with
3 drops Ferric Chl
10 drops Chloride of Calcium

Same with
15 drops Acetic Acid

Same with
½ fluid ℥ = { ½ olive oil / ½ Caustic Sodae } ℥ solution

2 ℥ ~~Chloride Calcium~~ NG

7½

2 oz Chalk
½ oz Chl Calcium

8½ 2 oz Chalk
½ oz Caustic Soda
Used Chalk
instead of Phos-Lime
through mistake

10 ~~1 oz Chalk~~
~~1 oz Dry powd. Chlor. Calc.~~

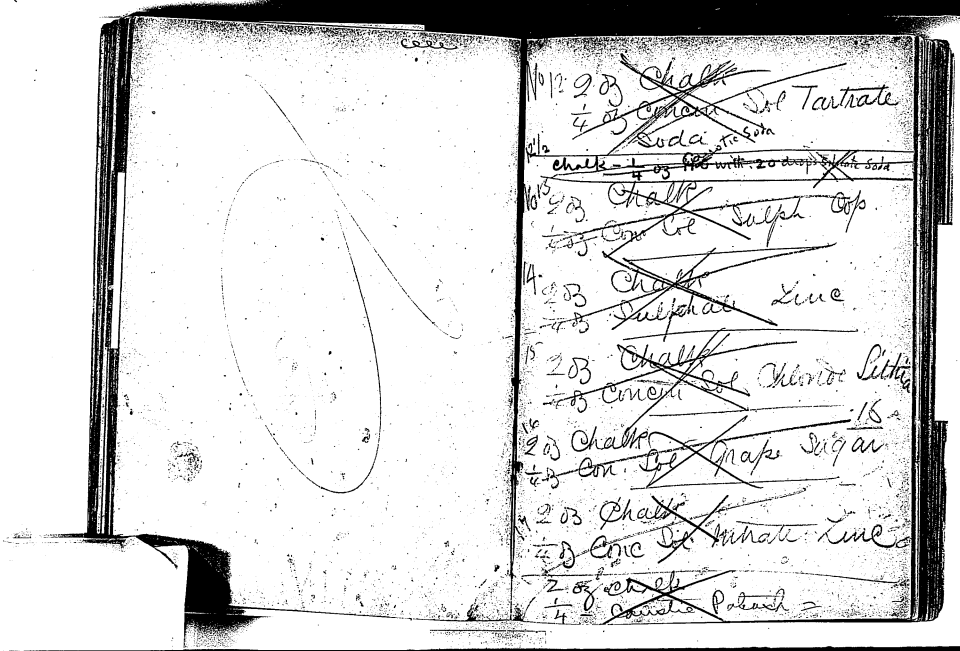
~~7½ oz Chalk~~
~~½ oz Dry powd. Chlor. Calc.~~

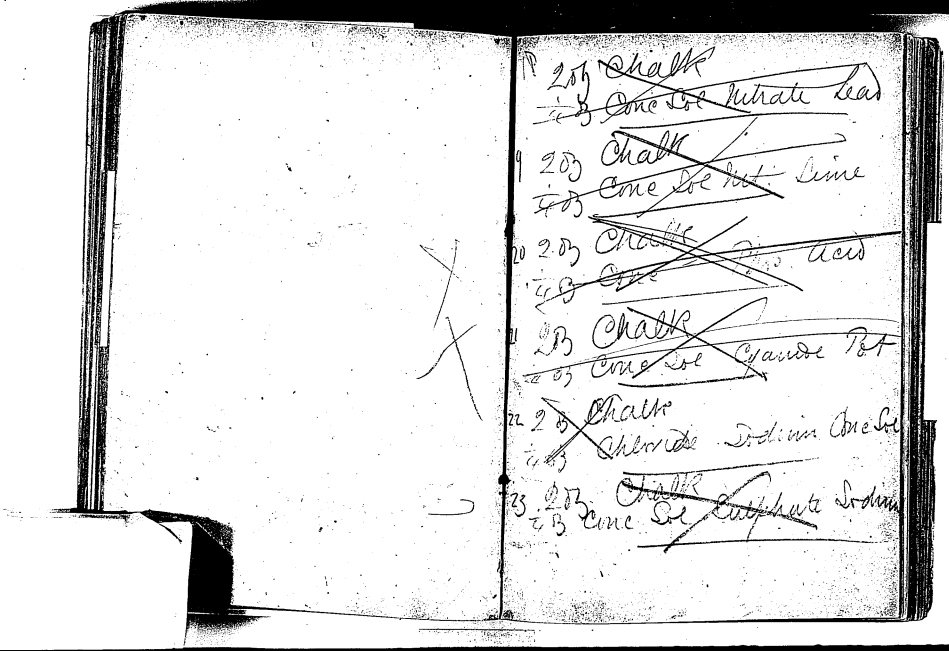
8 1½ oz Chalk
½ oz powd. Phosp. ~~Soda~~

9 2 oz ~~phosphate~~ Lime
¼ oz ~~Caustic~~ Soda

10 2 oz phos. Lime
~~¼ oz Concentrated Sol Chlor~~
Cal

11 2 oz ~~Chalk~~
½ oz Concn ~~Sol~~ Tartaric acid





2 oz Chalk
½ oz Conc Sol Sulphite Sodium

2 oz Chalk
½ oz Conc Sol Hyposulphite Soda

2 oz Chalk
½ oz Conc Sol ~~Permanganate~~ Potash

2 oz Chalk
½ oz Conc Sol Bichromate Pot-

2 oz Chalk
½ oz Conc Sol. Iodide Pot

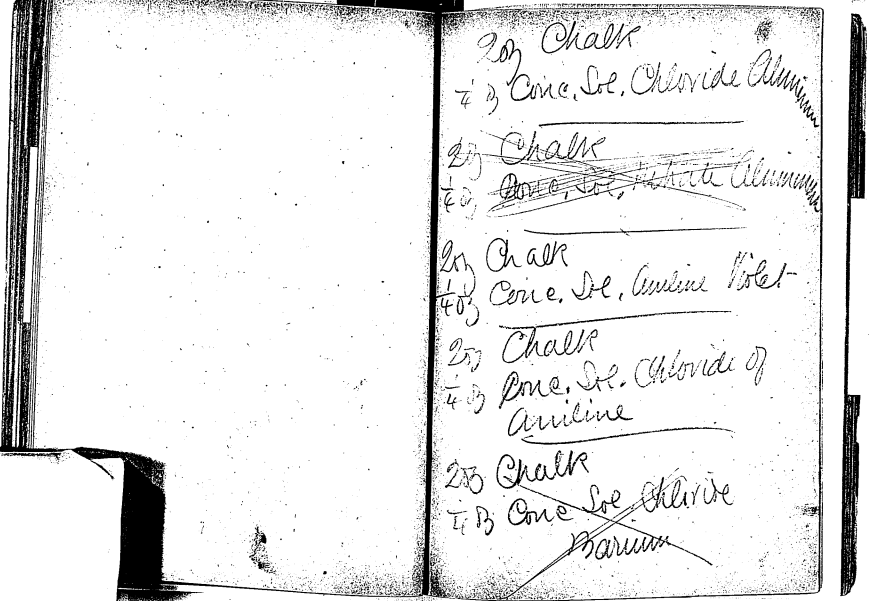
2℥ Chalk
¼ ℥ Conc Sol Ferrocyanide Pot.

2℥ Chalk
¼ ℥ Conc Sol Ferrocyanide Pot

~~2℥ Chalk~~
~~¼ ℥ Hydrofluoric Acid~~

2℥ Chalk
¼ ℥ Conc Sol Alumn

2℥ Chalk
¼ ℥ Conc Sol Acetate of Alumina


2 oz Chalk
1/4 oz Conc. Sol. Chloride Aluminum
2 oz Chalk
1/4 oz [illegible]
2 oz Chalk
1/4 oz Conc. Sol. Aniline Violet
2 oz Chalk
1/4 oz Conc. Sol. Chloride of Aniline
2 oz Chalk
1/4 oz Conc Sol Chloride Barium

2ʒ Chalk
¼ ʒ Conc Sol. Nitrate Bismuth

9ʒ Chalk
1ʒ Chloride Lime

1½ʒ Chalk
½ Chloride Lime

1ʒ Chalk
½ ʒ Eddy Lamplough
¼ ʒ Caustic Potash

2ʒ Chalk
¼ Conc Sol Chlor. Cadmium

2 lb Chalk
¼ lb Conc. Sol. Sulph. Cadmium

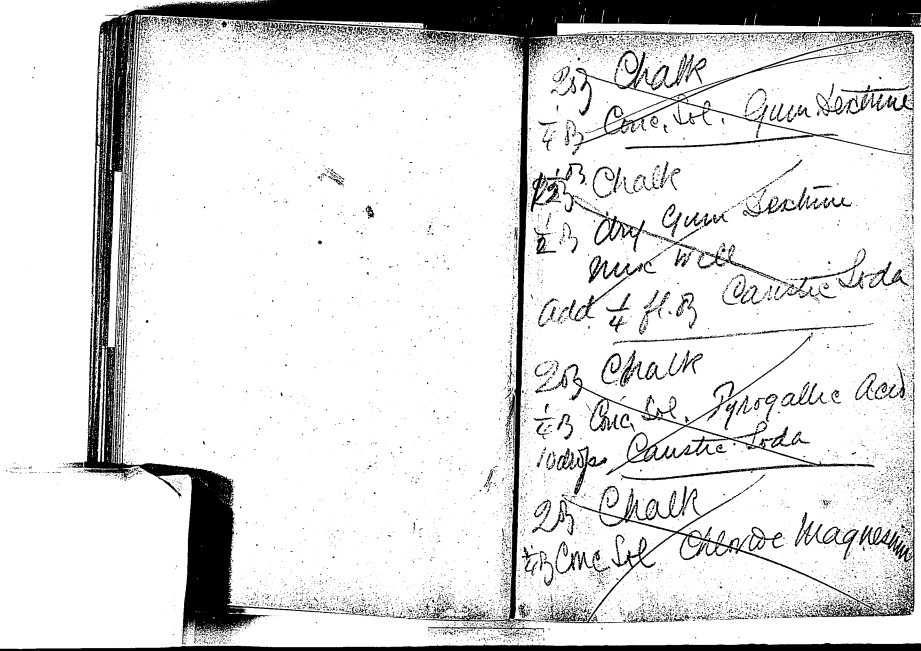
2 lb Chalk
¼ lb ~~Conc.~~ Distilled water

2 lb Chalk
¼ lb Conc Sol. Oxalate Cerium

2 lb Chalk
¼ lb Conc Sol Chloride Cobalt

~~2 lb Chalk~~
~~¼ lb Conc Sol Nitrate Cobalt~~

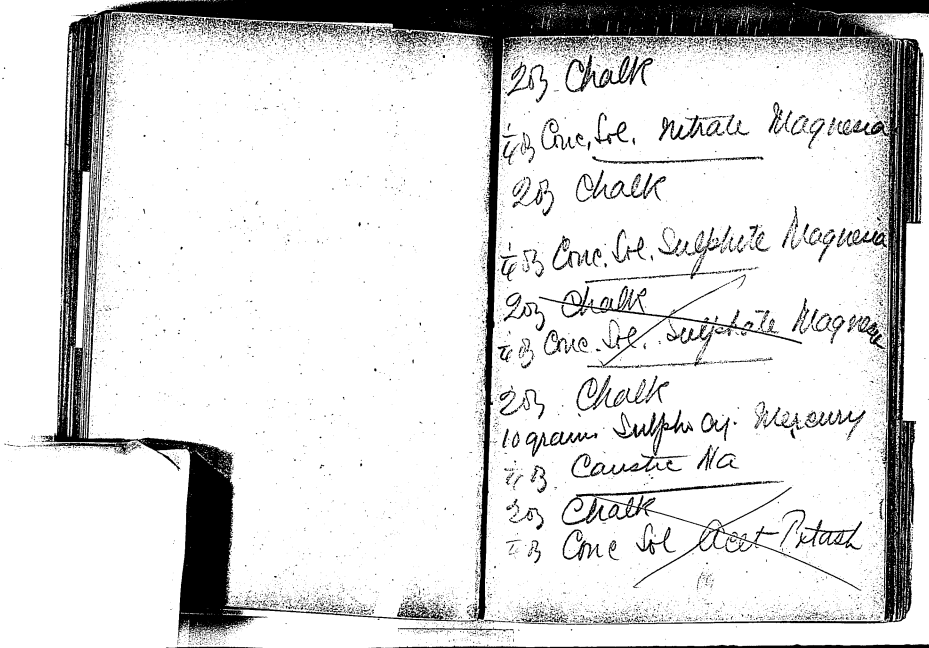
= Nos 15


2 ℥ Chalk
¼ ℥ Conc. Sol. Gum Tragacanth

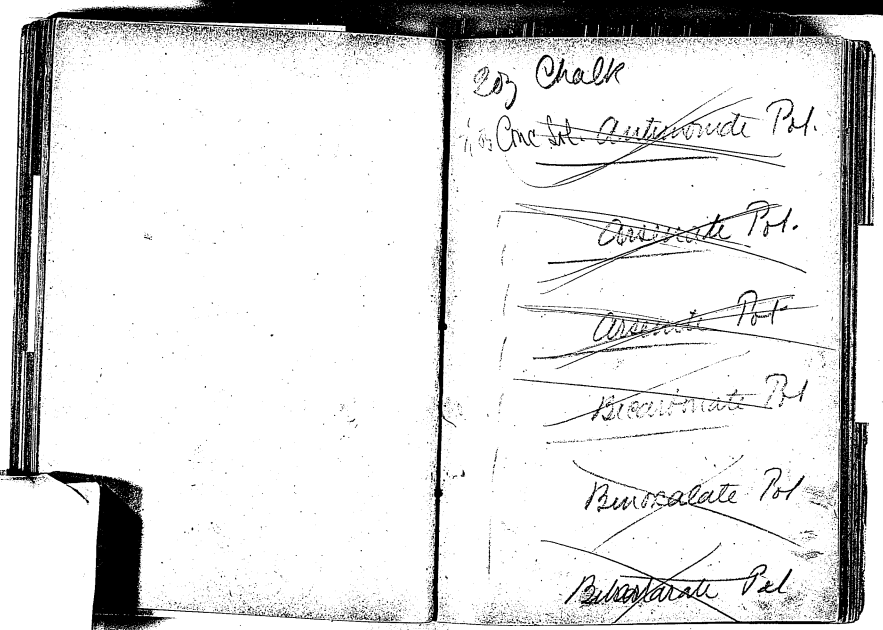
½ ℥ Chalk
½ ℥ Conc Gum Tragacanth
Mucilage
Add ¼ fl. ℥ Caustic Soda

2 ℥ Chalk
¼ ℥ Conc. Sol. Pyrogallic Acid
10 drops Caustic Soda

2 ℥ Chalk
½ ℥ Conc Sol Chloride Magnesium



2ʒ Chalk
½ʒ Conc. Sol. Nitrate Magnesia
2ʒ Chalk
½ʒ Conc. Sol. Sulphate Magnesia
2ʒ ~~Chalk~~
½ʒ Conc. Sol. ~~Sulphate~~ Magnesia
2ʒ Chalk
10 grains Sulphas Aq. Mercury
½ʒ Caustic Na
2ʒ Chalk
½ʒ Conc Sol ~~Acet Potass~~


Dog Chalk
Oxalate Pol.
Oxalate Pol.
Oxalate Pol
Oxalate Pol
Binoxalate Pol
Binoxalate Pol

~~Bromide Pot.~~

~~Chlorate Pot.~~

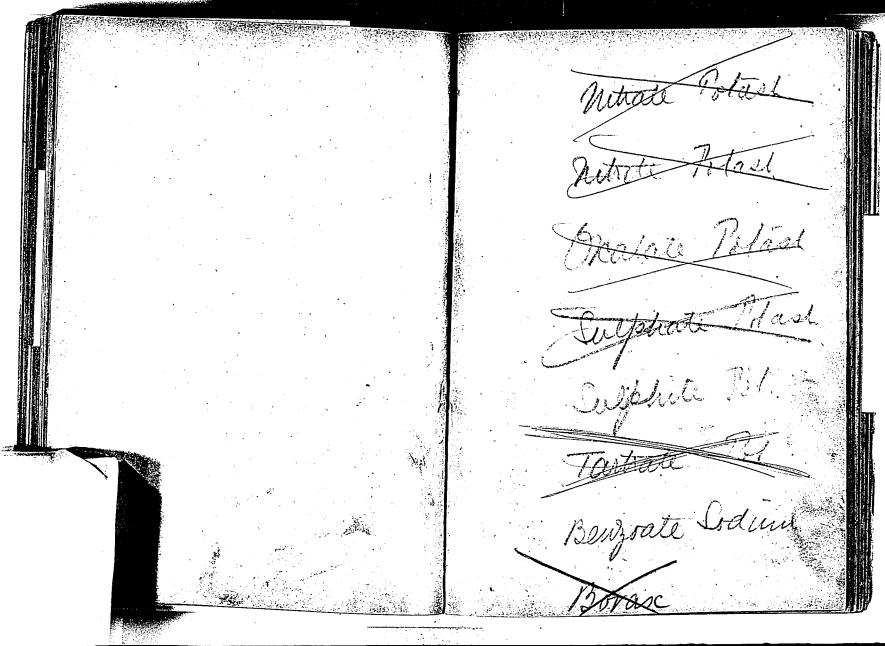
Chloride Pot.

~~Chromate Pot~~

~~Citrate Pot.~~

Hypochlorate Pot

Hypophosphite Pot


Nitrate Potash
Nitrite Potash
Chlorate Potash
Sulphate Potash
Sulphite Pot.
Tartrate Pot.
Benzoate Sodium
Borax

~~Chloride Zinc~~

Bisulphite Sodium

Bisulphate Sodium

Benzoate Sodium

~~Benzoic Sodium~~

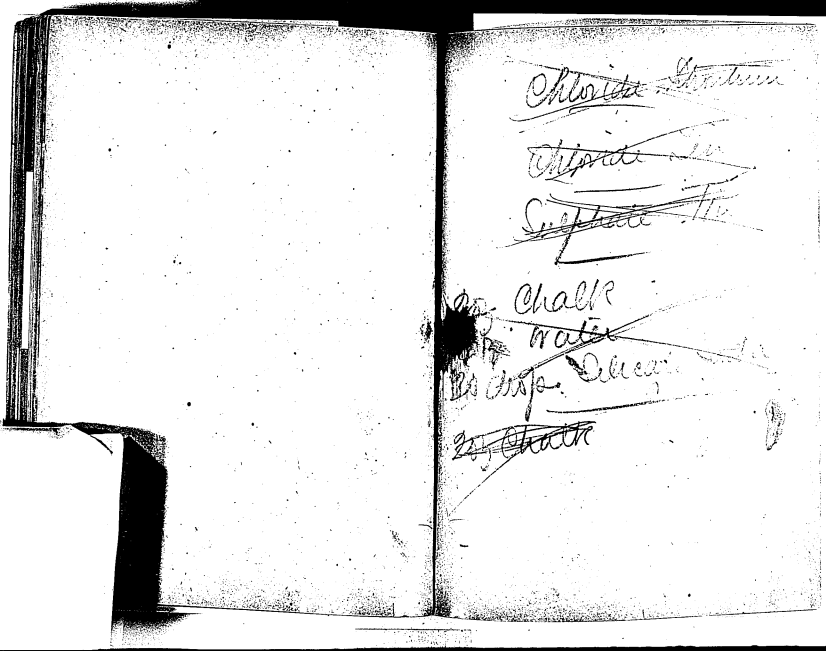
~~Salicylate Sodium~~

Citrate Sodium

~~Dextrate Sodium~~

~~Tungstate Sodium~~

Acetate ~~Chromia~~



2 oz. Chalk.
~~1/4 oz. Acetic Acid~~
~~No water~~

2 oz Chalk
1/4 oz (fluid) Phosphate
Soda

Edisons Telephone Sept 18th 1879

Chas Batchelor

We noticed that with our new telephones a fault in that the chalk never had so clear a track as noticed in former ones, after perusing this of persistently for four nights we find that there is considerable difference between our chalks now and previous lots, but on getting some "Extra precipito" found we were all right. ==

In our inertia telephones with Jablochkoff candle carbons in we noticed a deterioration and on investigation under microscope found undecorated with known staff.

I now took a piece of Jablochkoff Carbon

and heated it on bunsen burner and on examination under microscope it showed itself covered with brown fluffy stuff; scraped this off and heated again and same stuff came out in less quantity.

A piece of Wallace carbon under same treatment gave a white stuff and also showed some pieces of silica scattered over its surface also in telephone we noticed that some of the Wallace carbons were perfect insulators, probably due to one of these pieces of silica being in contact with platina instead of carbon

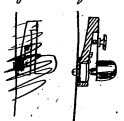
A piece of carbon stick that came from Mr Cleland and looking

like Thompson Carbon gave out no other stuff when heated but the grain was much coarser than either of the others

Used all these for transmitter also =

Used Plumbago which is very good but there is little margin of adjustment

We now altered the inertia cup to 9/16 and I cut a carbon button of our old style to size and put it in as :— This worked well



but not as loud as old transmitter we now altered the weight making it four times heavier but without any great difference.

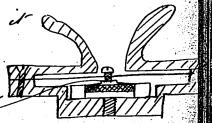
We now took the ordinary inertia again & put in a Platinum Black button

We made a brass sleeve to hold the carbon and forced into the mercury cup. in order to make one end of brass sleeve and also one end of carbon touch one platinum permanently and get the vibration all from the other face, these were very sensitive at a distance but were no improvement close too We tried this with Jablochkoff candle carbon, Wallace, St Clairs, plumbago, platinum black,

We now made some more tests on the old Carbon transmitter and found that it kept its resistance more uniform, was louder, could stand a large battery power, and in many ways was preferable to the mercury and decided to put them in our Long line telephones

This telephone transmitter which has never been beaten in loudness or distinctness by any body elses make owes its superiority to the fact that its adjustment is perfectly rigid and its surfaces perfectly flat — As the movement of the diaphragm at any time during talking cannot be more than the 1/001 of an inch, it stands to reason that if there is any shake in adjustment or any vibrating of parts it uses this movement all up in taking up such slacks etc

We propose to use it as:—



Sept 18 1879.

Chas Batchelor

Chas Batchelor

Edison Telephone Sept 18th 1879

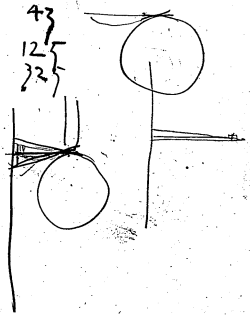
Asa Batchelor

One of the great difficulties with our inertia telephones is that after using some time a number were taken down and tested for resistance with same pressure on each. They varied from 140 ohms to 6 ohms and some were insulators. This variation would kill them entirely

Coils after paraffining

Prim. .43 Ohms.
Sec. 11½ "
Ter. 379 "

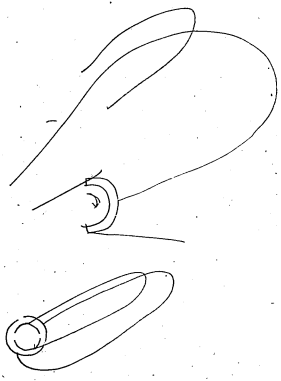
P 43
S 12.5
T 325

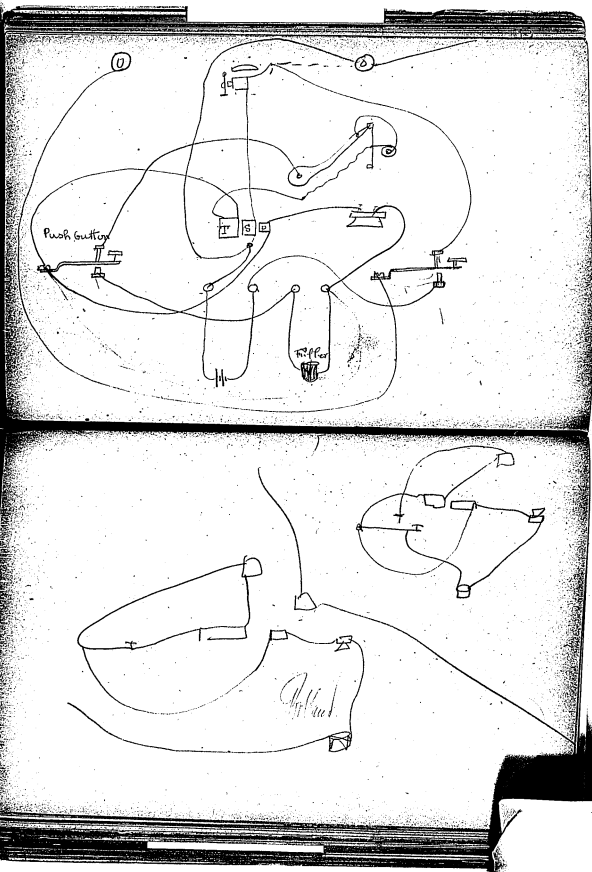


0037 1588 132

0005
50
37
130
121
40

132
1188
237




Push button
Trigger

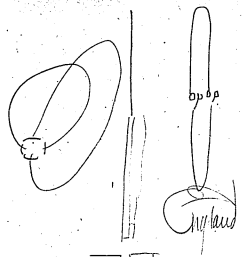
10

24

25

2
4
8
16
32
64

1/2
1/4
1/8
5/16



England

Portland

Portland

$2 \overline{)356}$ $\quad 17.80$

$1780 \quad 1780 \quad 18\frac{1}{2}$

$356\overline{)1780} \quad \overline{)1424} \quad 18$

$\quad 1780$

$\quad 3\,2040$

$12 \cdot$

$12 \overline{)78.} \quad 6\frac{1}{2}$

$102 \quad 255 \quad 40$

$102 \quad 36 \quad 6$

$204 \quad 1 \quad 240$

$2\frac{1}{2} \cdot 1004$

$62\,00$

620

$2\frac{1}{2} - \frac{1}{16}$

$6200 \quad 6200$

$12400\,00$

372000

$5840\,00\,00$

16

16

96

16

$25\,6$

$24 \quad 102,400$

1900

16

17400

17000

4000

18

$17\frac{1}{10} \quad 97 \quad 7$

$\quad 77$

$\quad 679 \quad 6$

$6\,73 \quad 4$

$94\,09$

$\quad 6$

1000

17

12600

17000

$3\,1000$

1900

15200

$3\,2\,200$

9409

44

37636

37636

$218 \overline{)413996} \quad (1895$

$\quad 218$

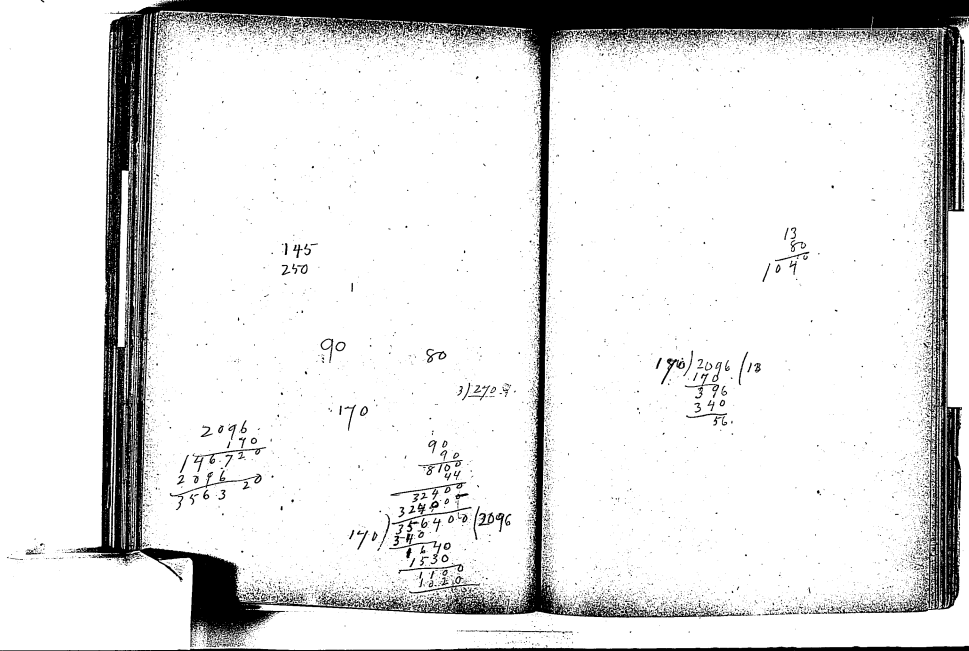
$\quad 1959$

$\quad 1844$

2154

1971

$18\,6$



145
250

90

80

170

3)270.8

2096
170
17672 0
2096 20
3563

90
90
8100
32400
32400 0
170)3564000(2096
340
2440
1530
1020
1020

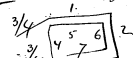
13
80
1040

170)2096(18
170
396
340
56

Present armature

any 10 X 10 in

A



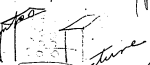
8 1/2 turns

.14 ohm

#24 wire

present armature

10 : 1



11 lamps

11

.14

140 | 1960.0

98

20

.7 H.P on armature

amps 60 | 2116 | 45 | 5964 sq in

1200

2+

3.2 times the amps can be carried

3.2

.7

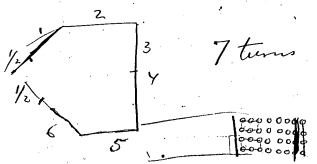
2.14 H.P current

2.14

2.14 lamps

1

20 inch armature



7 turns

$\frac{6}{24}$ A per foot

$\frac{7}{8.5} \times \frac{6}{24}$ the resistance of

A

X X $\frac{7}{8.5} \times \frac{1}{4} \times 2$

37.6

2.49

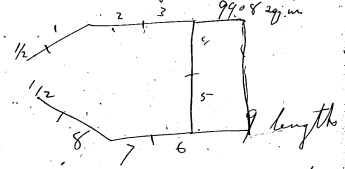
.117 | 49 (28

34

150

.028 ohms resistance

20 inch long
20 inches long
7436 sq. in.



1/2 the commutators to give E. M. F.

96 then 4 to 2 then 1/3 resistance per foot

48 wires in place 24
1/2 the length
1/4 the resistance
1/6 the resistance

.002 .004 .024 4/24 X 1/4 = .006 ohm

.001 .007 .028 9/28 X 1/4 = .009 Ohm

If square wire can be used .005 Ohm

120 H.P.
120 / 840) 100.0 (.12
840
1600

8 in the current
.001

24 : 1 square wire

120 / 960

13 : 1 round wire

75/2 = 37.5

39 coils will do it.

$\frac{11}{9} \times .009$

.011 Ohm

.11) 100.00 (909 lamps
99
100
99
1

120
8
960) 100.00 (.1
960
400
1400000 13
10
13 00

Diagram connections machine

Diagram of system

The ~~Coops~~ Machines

Keep ~~dirt~~ armatures dry and free from chips or dust

In case of excessive heating examine carefully, if one coil is black, it shows that ~~the~~ it is crossed and that the machine is worthless unless it is rewound. This coil may be pulled out and a single wire run into place

If the bearings heat

Keep the arms on which the brush holders are fastened clean so that no cross will occur

In adjusting the commutators ~~Xxxx~~ avoid going too far so as to strike the base of the machine.

A side ways movement of brushes ~~xxxxxxxxxxxxxxxxxxxx~~ may be given to bring them ~~xxxx~~ in a new track on the commutator.

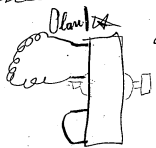
after brushes become smooth ~~xxxx~~ on one side change sides. The shaft on which the brush arms can also be slightly changed

The commutator should be kept carefully wiped with a piece of woolen cloth having a little oil on it.

The brushes should have no loose ~~xx~~ wires and should be placed opposite and so that the least possible spark occurs. As soon as ~~the~~ a wire is worn through it should be cut off so that there rests against the commutator only the sides of wires

If the covering over the commutator become torn repair immediatly and be sure no dirt gets in between the blocks before repairing at A.

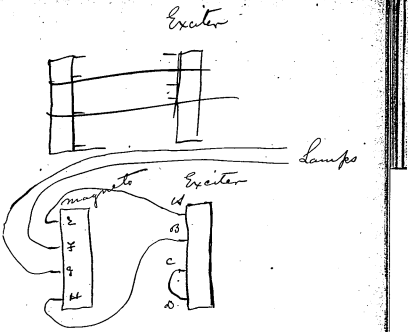
The exciting machine to act must have connections made like this



or

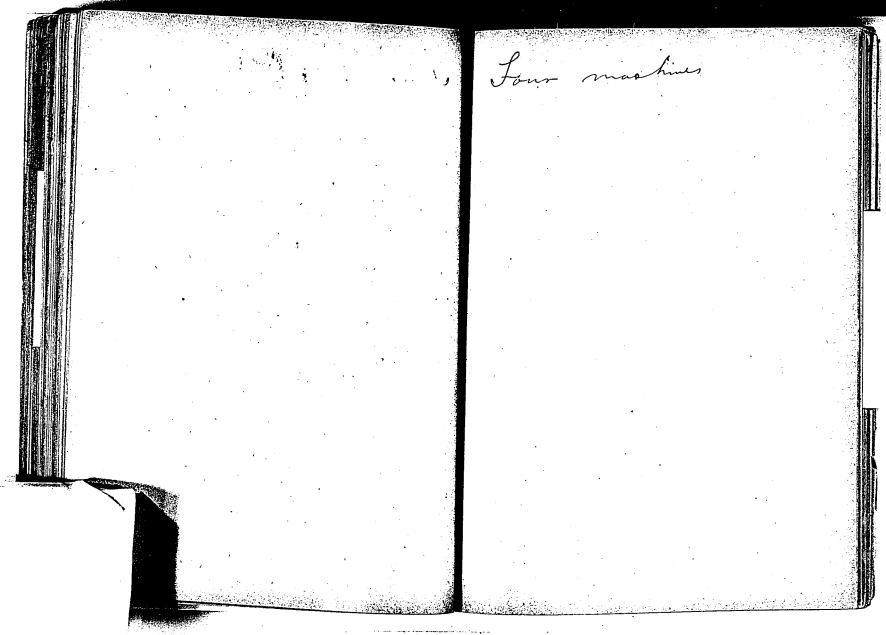
That is if a spark cannot be obtained by A, B will always give one.

To run machine from the exciter connections are made thus

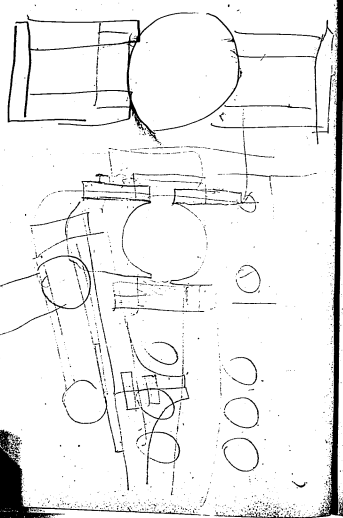


~~Four connections are~~ as follows.

The current starts at A


Four machines

To connect the machines a good way is to start slowly after the connections with the magnets have been made, and the lines at the switch board are all disconnected. Then put the middle or armature binding posts of one machine in connection with the main line. Then of a second machine, if the connections have all been made correctly there should be little or no sparks seen on taking out the plug. But if not, a



considerable. Work may occur. Then try the third machine.

When the belt is off of a machine and the other machines are running never put the plug in of that machine.

~~Lubricating~~

~~Lubricate of Lamp~~

~~Changing~~

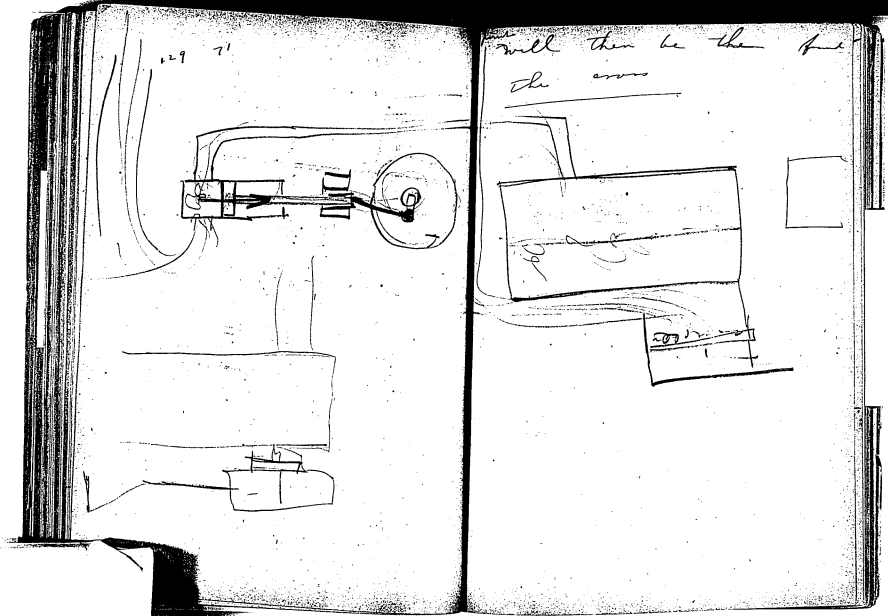
The state room

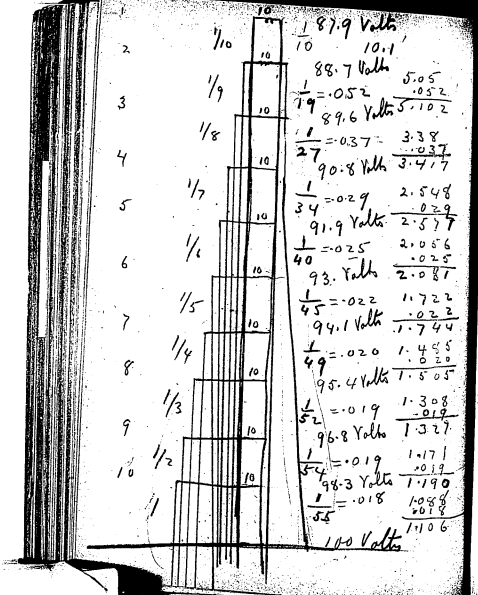
Lamps gone out
First see if the carbon
is broken if it is
change lamps. ~~Burn lamps~~
~~carbon very easily~~ If
no fault can be found
in the carbon examine
the safety clutch if that
is gone it shows that
there has been some ~~trouble~~
trouble with the line Put
in a new clutch and
try if that melts off
the trouble is in the
lamp or short line leading
to it. Disconnect the lamp
and try a new safety
clutch if that burns the

is in the short line
If not take down the
lamp and examine the
two wires leading into
it four crosses.
If the safety clutch
is all right examine
the connections leading to
the lamp. If they are
all right turn the
key in the switch several
times and reexamine the
carbon. Then if no trouble
can be found cross the
two wires that lead
into the lamp ~~so that~~
to see if the safety clutch
melts off. If it does take
down the lamp. If it

does not examine line and switch for track.

If ever the main wires become crossed, run the machine slowly and follow along and the cross cannot be found by tracing over the lines. Run the machines slowly and with a compass needle trace over the line to see when it stops giving a deflection at which





$$\frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{R} \quad - \quad -$$

$$R = \frac{R_1 R_2}{R_1 + R_2} =$$

$$\frac{\frac{1}{10} \times \frac{1}{9}}{\frac{1}{10} + \frac{1}{9}} = \frac{1}{9+10}$$

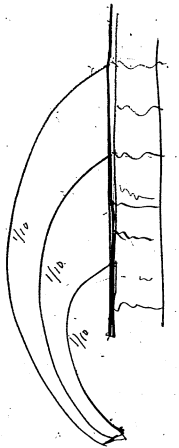
$$\frac{\frac{1}{a} \times \frac{1}{b}}{\frac{1}{a} + \frac{1}{b}} = \frac{1}{a+b}.$$

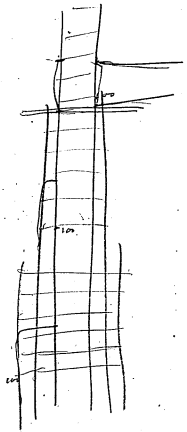
$$\frac{10.1 \times 10}{20.1}$$

10.1) 10 (.5
5.05
.052
5.102

5.102) 5.102 (3.38
453
.037
572
453
3.417
1190
1208

5.05 — 2 95-256
5.102 — 0 70329
comp — 9.29226
7.94811


1/10
1/10
1/10



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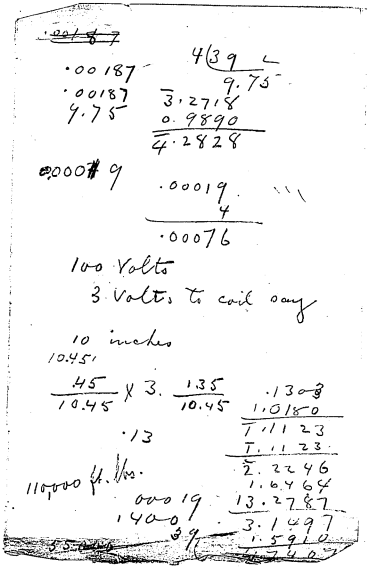

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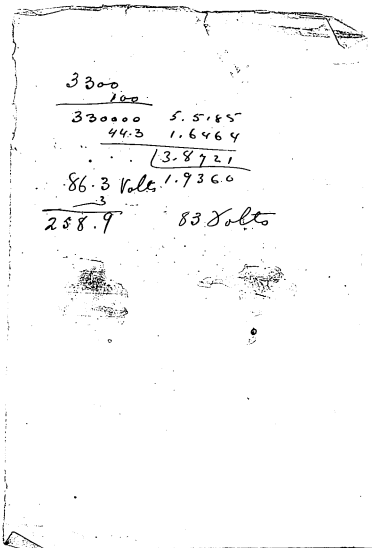
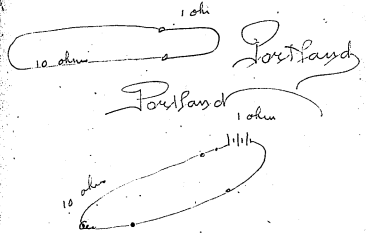
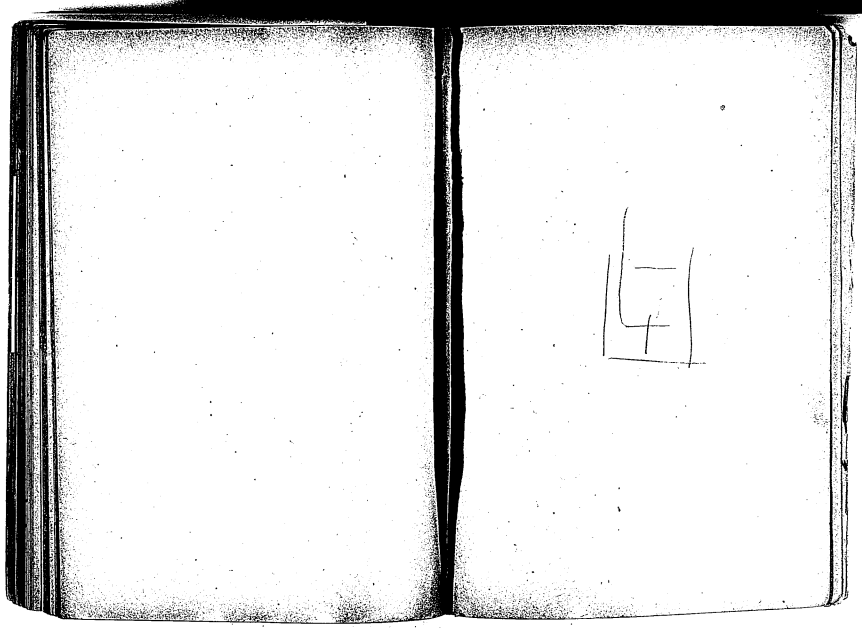
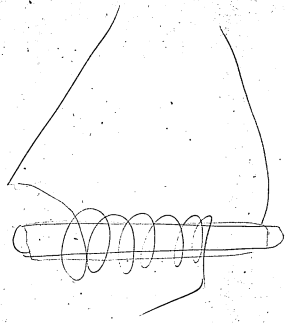
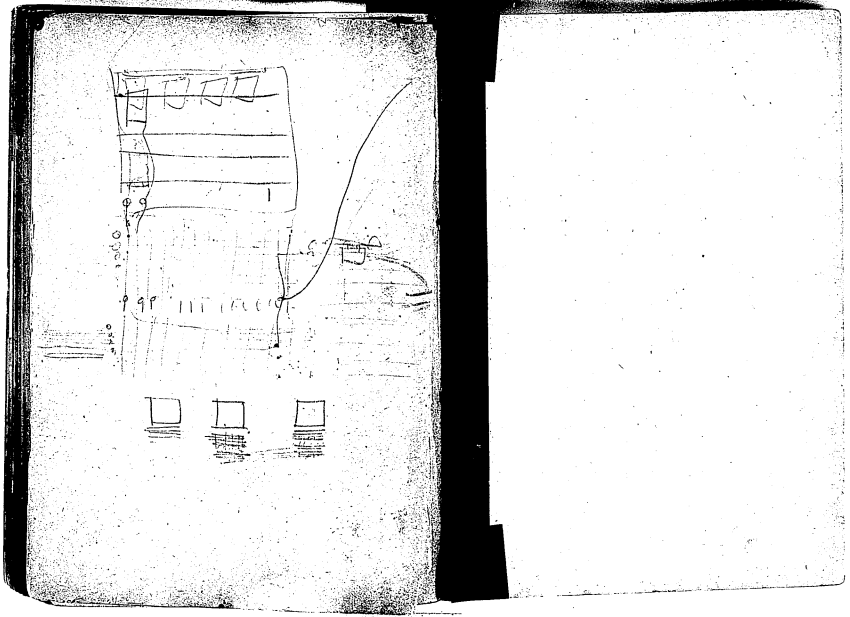



1 ohm
10 ohms
Port Said
Port Said
1 ohm
10 ohms







Menlo Park Notebook #46 [N-79-02-10]

This notebook covers the period February-July 1879. Most of the entries are by Edison, Charles Batchelor, and Francis Upton. A few entries are by John Kruesi. Included are notes, calculations, and drawings of generators; calculations about electric power distribution; drawings of telephones and central exchange systems; notes and drawings of dynamometers; and notes and calculations about thermoelectricity experiments. Also included are a memorandum by Edison on the English telephone business and a memorandum by Batchelor on outfitting the Jeannette for the New York Herald's arctic expedition. The book contains 274 numbered pages.

Blank pages not filmed: 110-111, 200-205, 222-225, 260-273.

Missing page numbers: 99-100, 113-114, 173-188.

No 46

Menlo Park NJ
Edmonton

Edmontown
Newark

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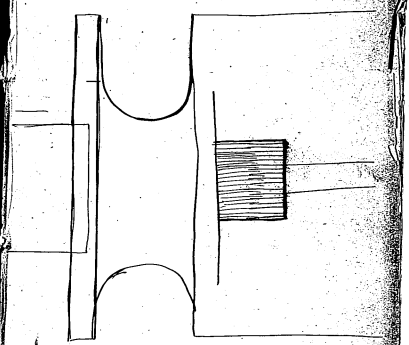
120 BROADWAY, NEW YORK.

, 189

Feby 10 1879
TAG

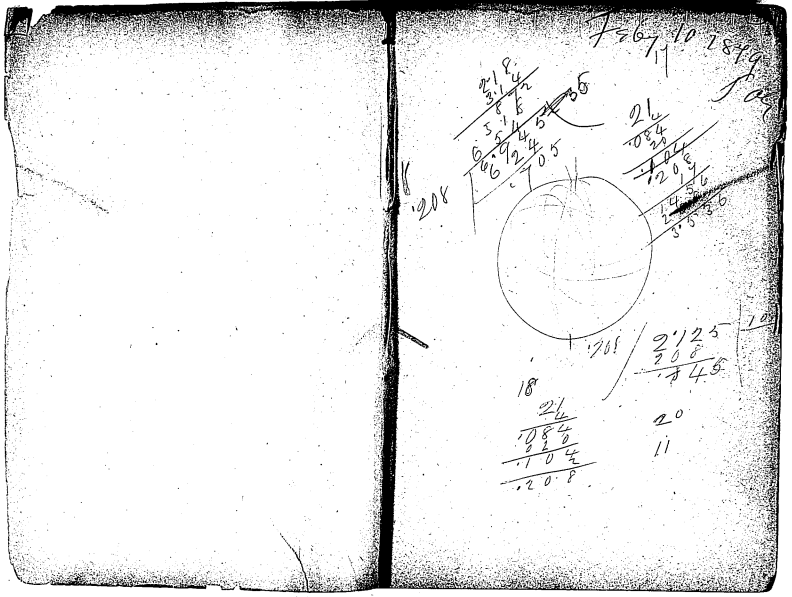


7046

Menlo Park NJ
Unionlown

Unionlown
" Newark
What der yere say

Feby 10 1879
Jag



Feby 10 1879

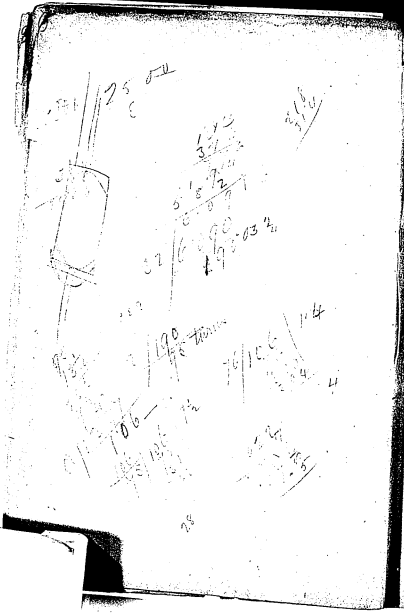
.25
27 | 2.16 | 9
2
4½

90
27 | 6.94 | 28
5
194
168
26

.28
14

2½
12
2½
125

50 divisions
Wire 26 5 turns 2 layers
Width of groove .705



Small Magneto Electric –
Armature of No 22 wire

Diam of Arm. ~~.2~~ .194 Circum 6·09

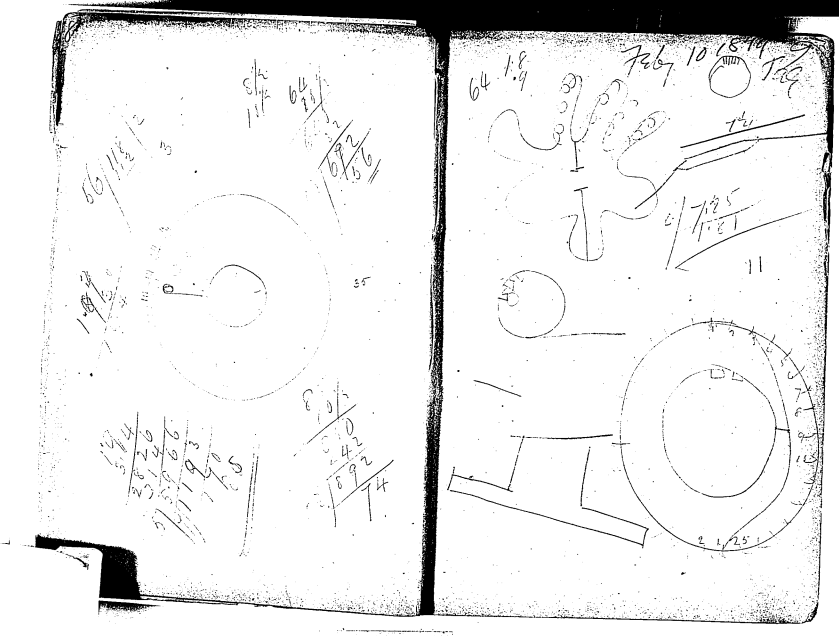
22 wire with covering = .029

Armature wound with 95 full turns
will will measure 1277 inches about
= 106 feet = 1·4 ohms.

Shell wound with No 26
No 26 with silk cover is .022 thick
Diam. Shell 2.18 = 6.945 circum
Wind 25 full coils of 4 turns each
2 Layers = each coil 9ft long
Resistance of 25 coils 7.25
halved & connected 1.81 ohms

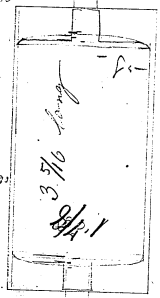
See page 18

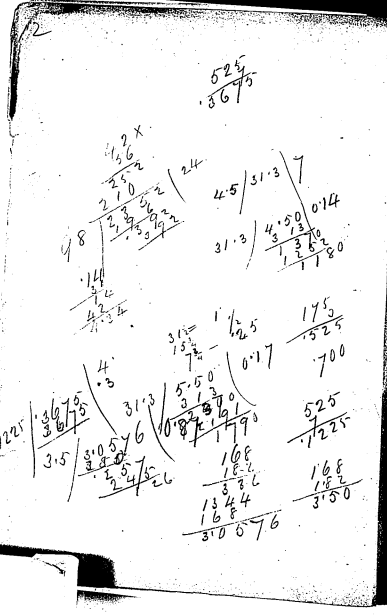
F. G. 10 1.871 Tag



Armature wound with about 1/4 turns of No 21 iron wire two circuits 8 ohms.

85 turns of 21. Another ends 8 short of turns 21. Adjacent crossings on shaft.





26 wire 31·3 feet per ohm

$4\frac{1}{2} + 4\frac{1}{2} + 4\frac{1}{2} = 13\frac{1}{2}$ $13\frac{1}{2}$

$4\frac{1}{2} = .14$ ohm

$\frac{42 \times 56}{42 + 56} = \frac{2352}{98} = .24$

$5\frac{1}{2} = .175$ ohms

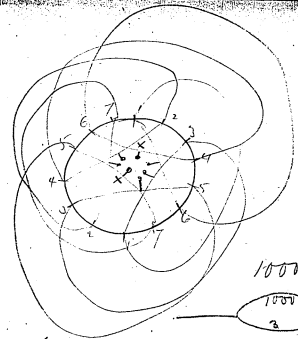
$\therefore \frac{.525 \times .7}{.525 + .7} = \frac{.3675}{1.225} = .3$ ohms

each coil .14 ohms

first side .14 × 12 = 1.68 ohms

second side .14 × 13 = 1.82 ohms

$\frac{1.68 \times 1.82}{1.68 + 1.82} = \frac{3.0576}{3.5} = .87$


1000
1000
3
1003/3 000
4-
1
3
5
6
2
7
25
12
13
Feb. 10 12 ng.
TAE

6

6·70

We had 67 feet on the
armature

11 inches goes round

3·45 + 3·45 + 4·25 = 11·15

67 = 804

11·15 | 804·0 | 72

780 5

2350

2730

144

150

Feby 11 1879

Tag.

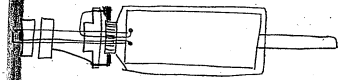
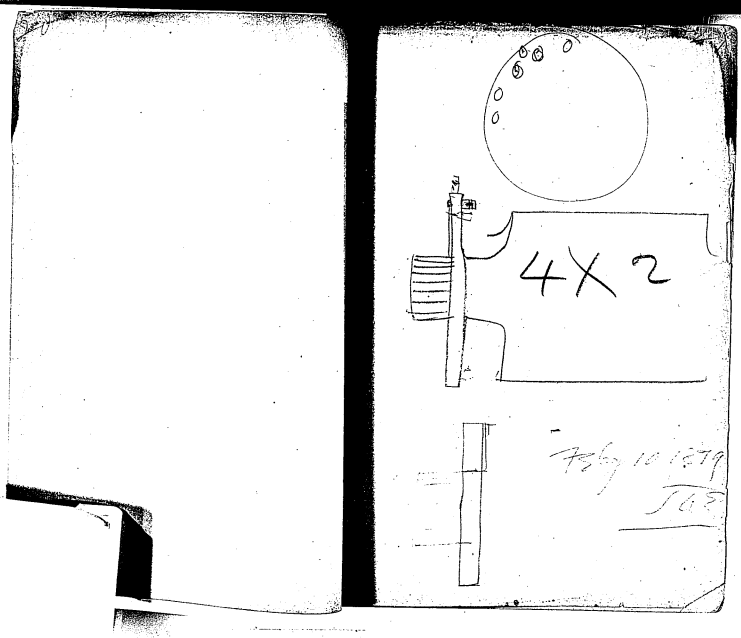
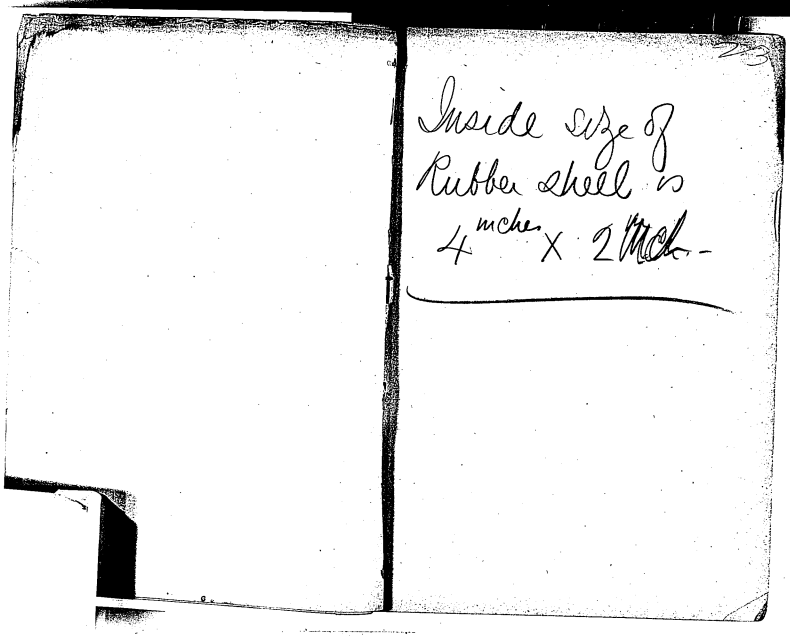
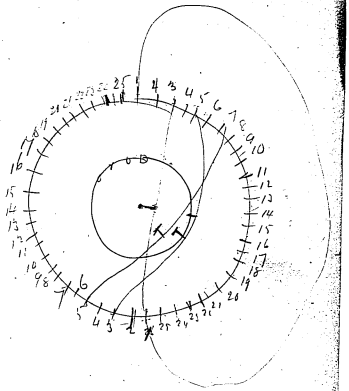


Fig 10 1879

IdE

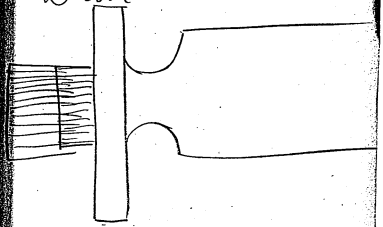

4X2
Feby 10 1979


Inside size of
Rubber shell is
4 inches X 2 Inch-



26

Dear -



July 12 1847
JAE

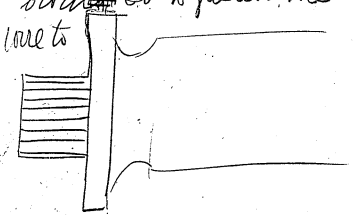
28

29

Feby 12 1874

Dear Jae

Take the shell and alter it so — make the communitators blocks stand out and cut put a flange on the blocks so to fasten the lowe to



take the brass pins
out of the rubber pads
and put rubber pins on
the top between the coils
at the connection end

Aug 2 1879

TAE

March 9th 1879

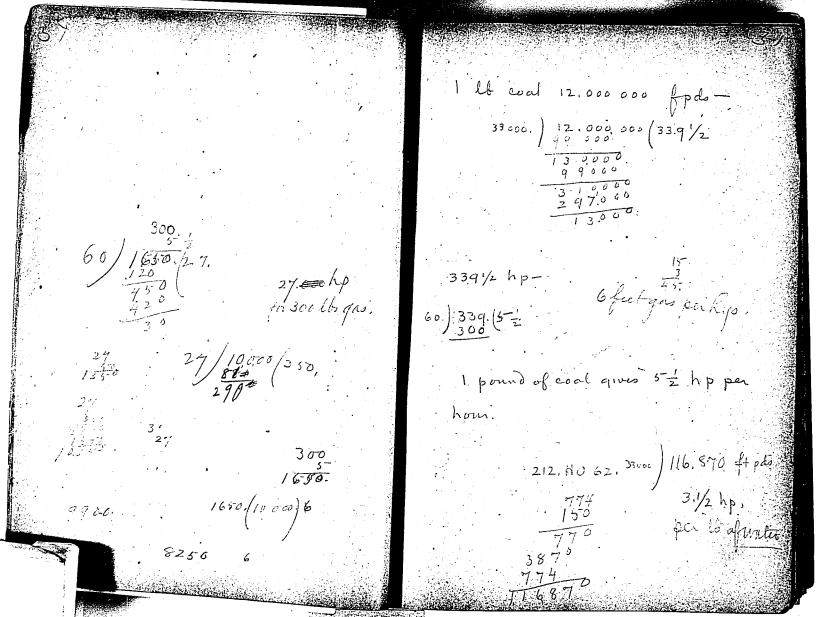
Alterations on Maquets

Bore out the (poles) so that they will have $\frac{1}{32}$ play on each side after ~~the~~ shell is served with thread

Shell must have 4 rows of pins round to guide in winding

Shell must have 2 layers of sheet turns each of #21 wire on it

GDT



1 lb coal 12,000,000 ftpds —

33,000.) 12,000,000 (33.9½

339½ hp —

60.) 339. (5-½

300

6 feet gas per h.p.

1 pound of coal gives 5-½ hp per hour.

212.40 62.5 lbs) 116,870 ft pds

3.1/2 hp, per lb of water

300 / 60 = 5

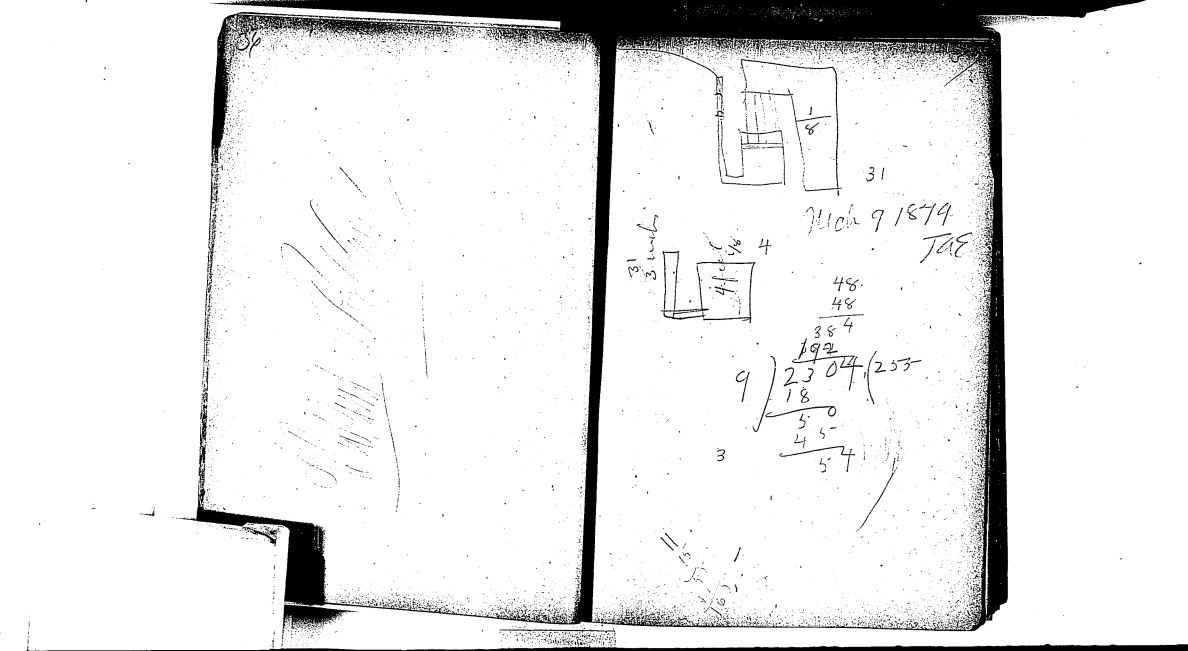
1650 / 60 = 27.

27 hp in 300 lbs gas.

27 / 10,000 (350,

1650 / 10,000 / 6

8256 6


1/8
31
March 9 1879
JAE
31 3 inch
4 Floors
1/6
4
48
48
384
192
2304
9
18
5
4
5
4
3

22
2
44

1

12 1100
6
6600. burns / hour

2500 burns per hour

1 burn 2500 hours,
1 " 900 "

10 400. 25 - 6 per hr

1650. hp for 300 lbs gas
leaving 1700 lbs coke
10000 feet.

300.

150. hp.
6
900.

750 Rev

2 feet ⟹ 1500 per min

750
9
6750

3 feet a sheet . 9 sheet. — 6750 ft per minute

42

7/4 21 wine 99 Joe 10 Ohm

99 / 7693 / 307

99 · 7 · 84 · 84 / 84 / 42

12 = 84 · 7 6 · 91 · 7644

84 × 91 / 84 91 = 7644 / 175 / 7644 / 700 / 644 / 48

1 6

C = E/R = 1/1 = 1

R = E/C = 1

EMF = E = CXR

84207
84207
589449
168414
33682 8
6736 56
7089188849

Maud Muller on a summer

50,
100 Reg Cent,
2141. P 02141.

40

1879
35
217

45

EMF. 1 Bunsen

+ 1 ro

0 to 100° C

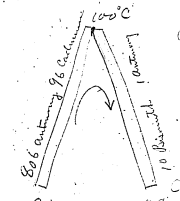
80 C antimony 96 Cadmium against Cu

gives + .02141 Dan

10 Bismuth 1 Antimony

gives − .00520 Dan

If the two be put in contact



March 9 1879 JOE

.02141
.00620
.02761

Current $\frac{2761}{100000}$

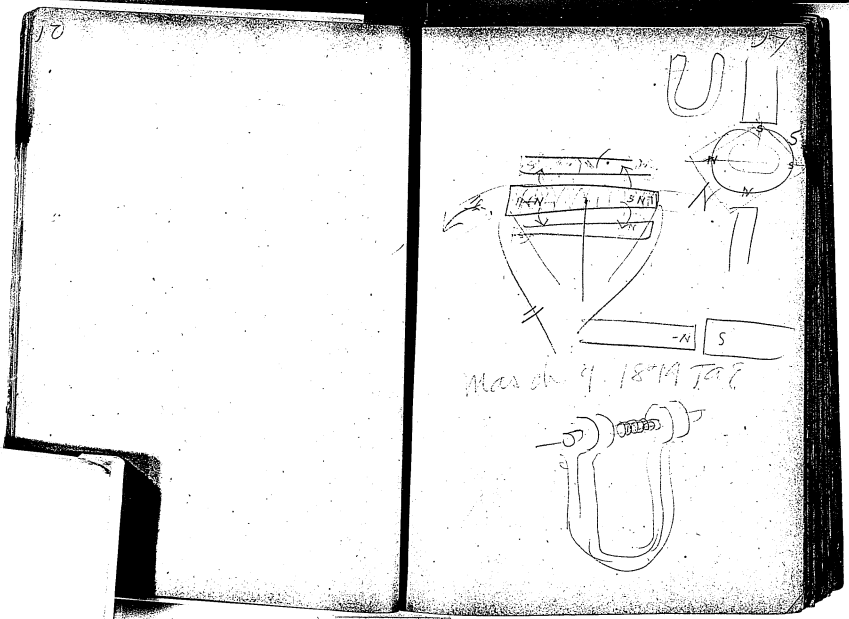
$= \frac{1}{36}$ Daniells

2761) 100000 (36

17170

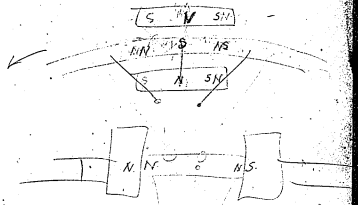
.0399
.0039
.0438) 1.000623.
876
1240

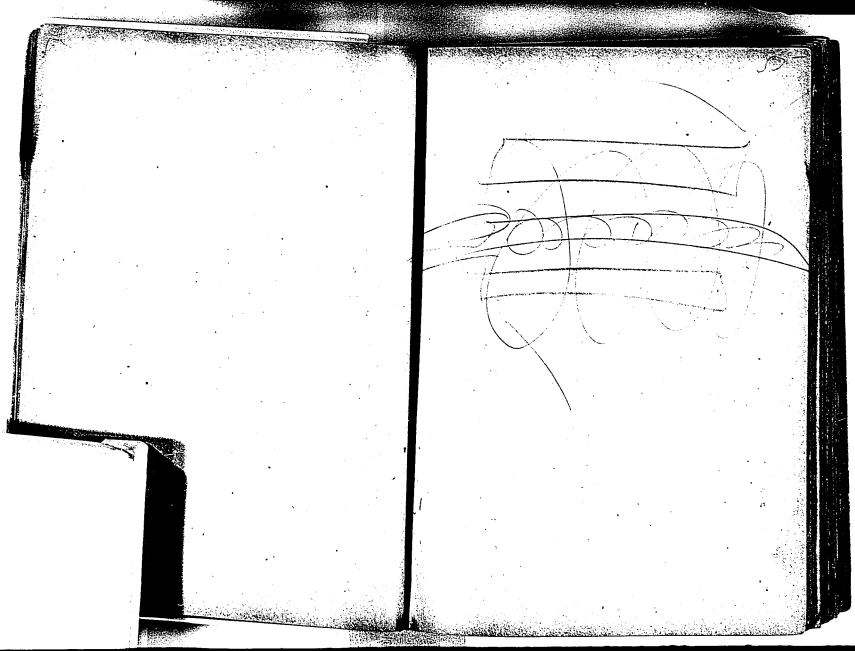
$\frac{1}{23}$ Daniell's

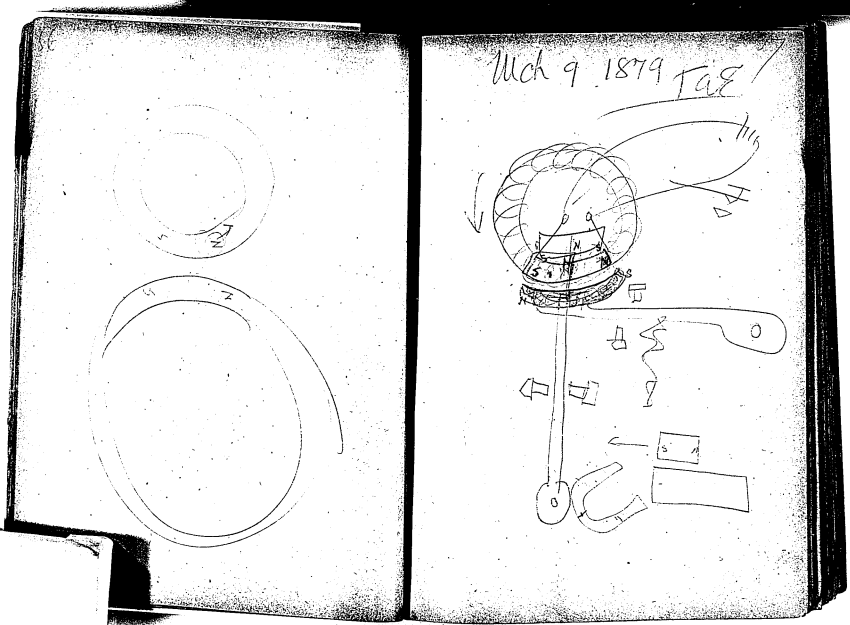

N
S
N
S
N
N
S
N
S
Mean dip 4. 18°M Tas E

92

93

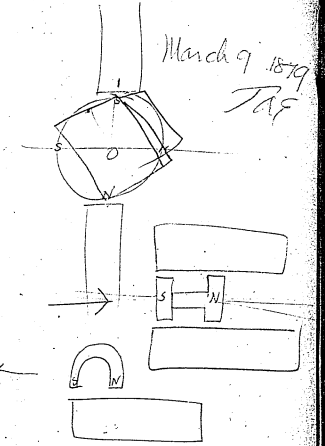


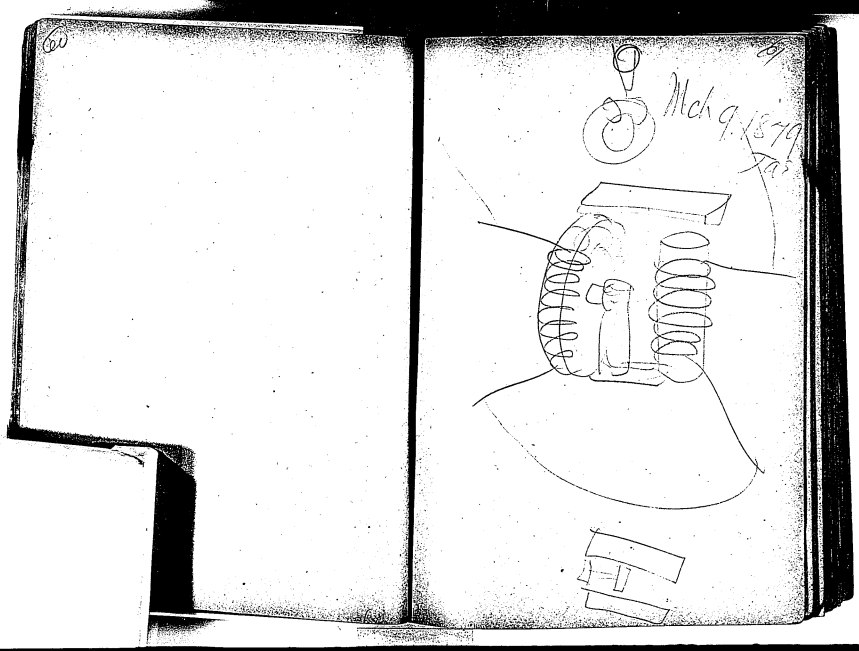



Mch 9 1879 Tae

March 9 1879

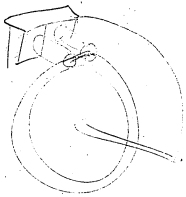
TAE




Mch 9 1879

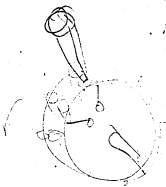
62

Mch 9 1879
TaE



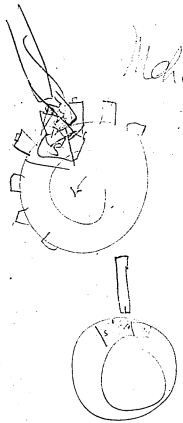
66

65

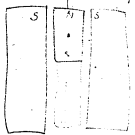


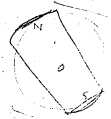
March 1849

JAE



May 1879
Tab


S
N
S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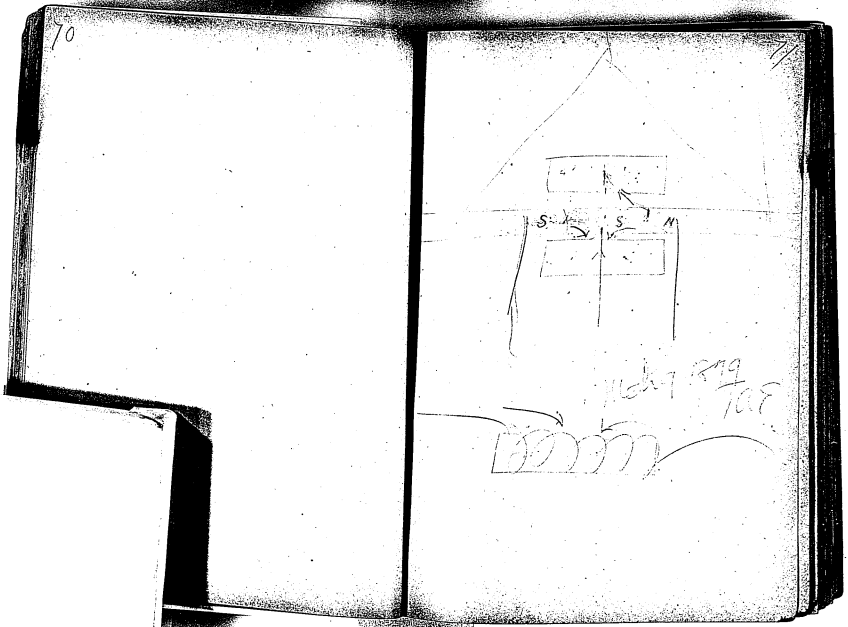
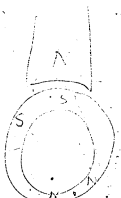
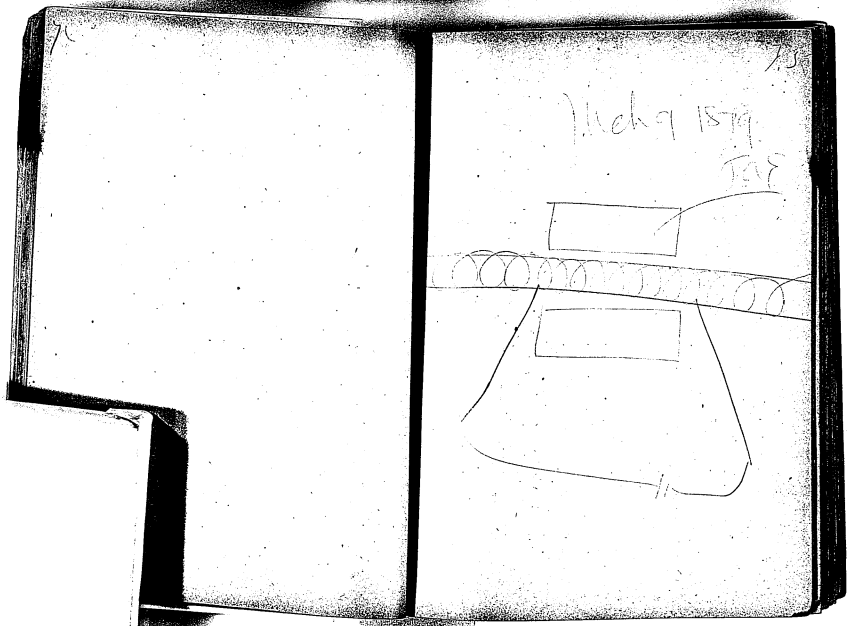

70
S
S
M

72



Magnets
Jdt

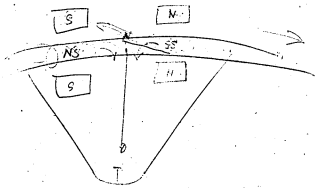


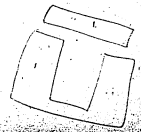
16

17

S W

Nichols 1879
Tas



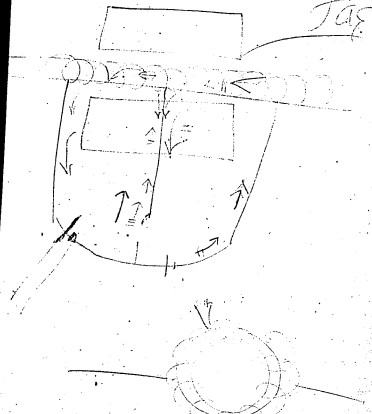


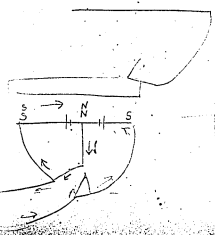
78

79

Wed 15 1879

Jas

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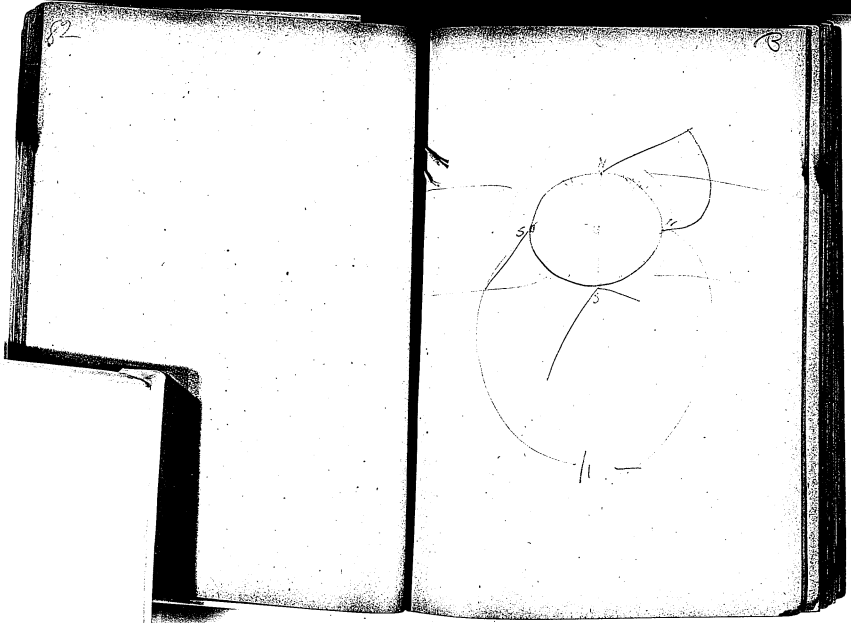
52
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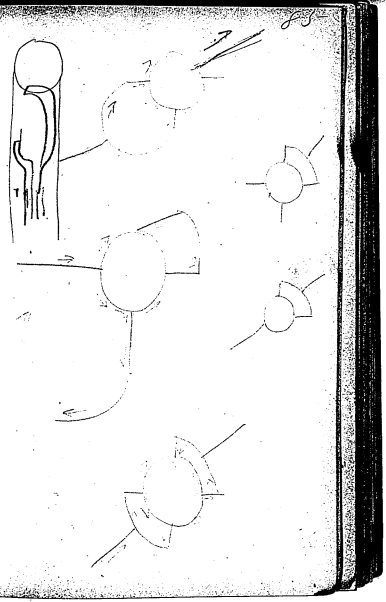
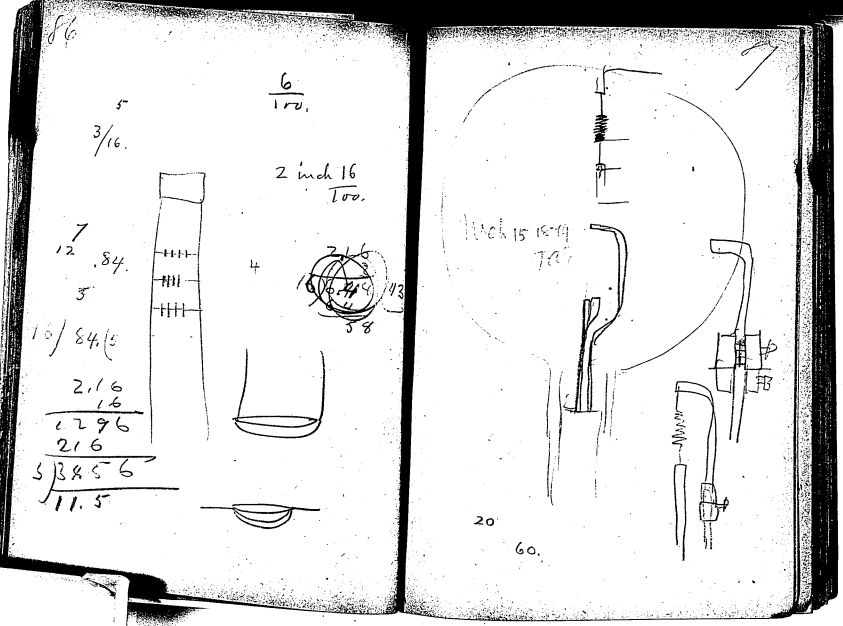
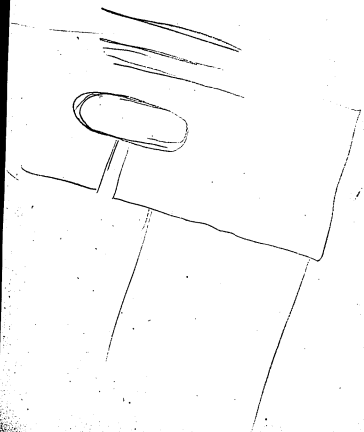
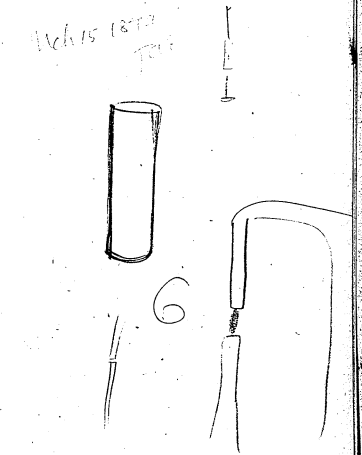
11




6
Two.
5
3/16.
2 inch 16
Two.
7
12
.84.
5
4
10/84.15
2,16
16
12 96
216
5 3 8 5 6
11.5
20
60.

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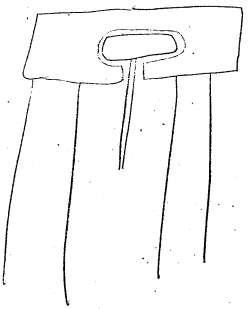
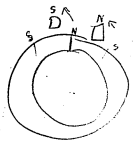
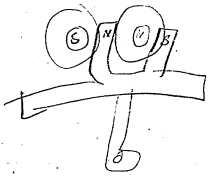
92

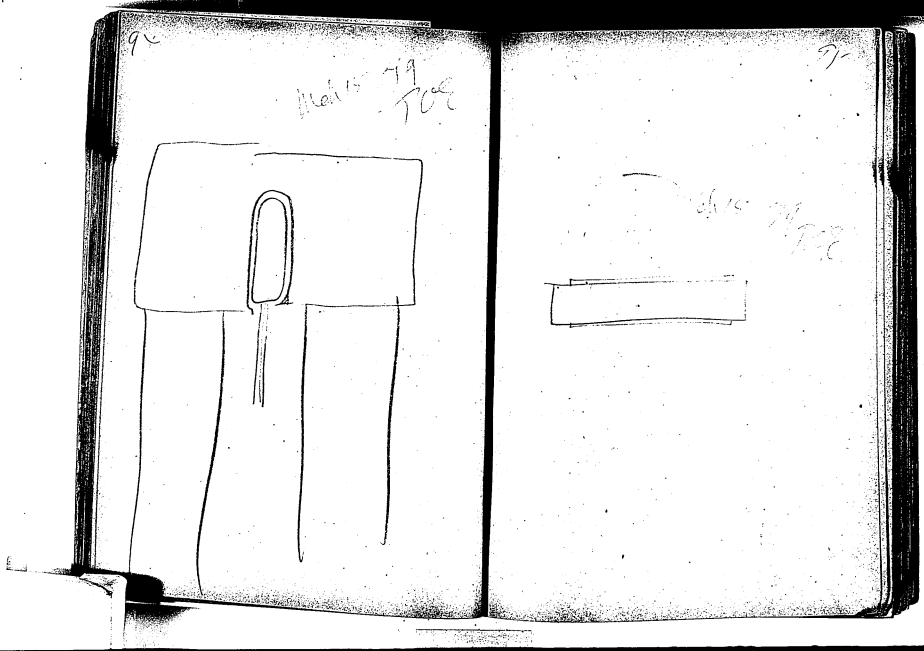


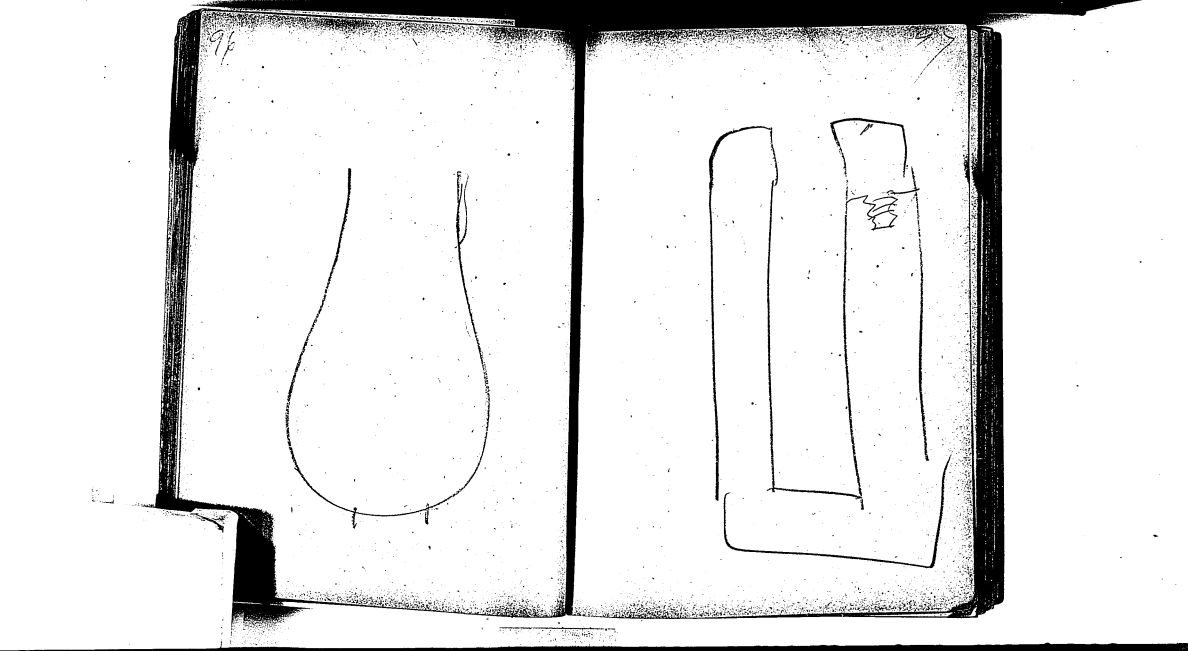
93

MCH 15 1999 TM









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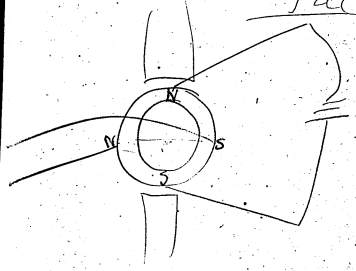
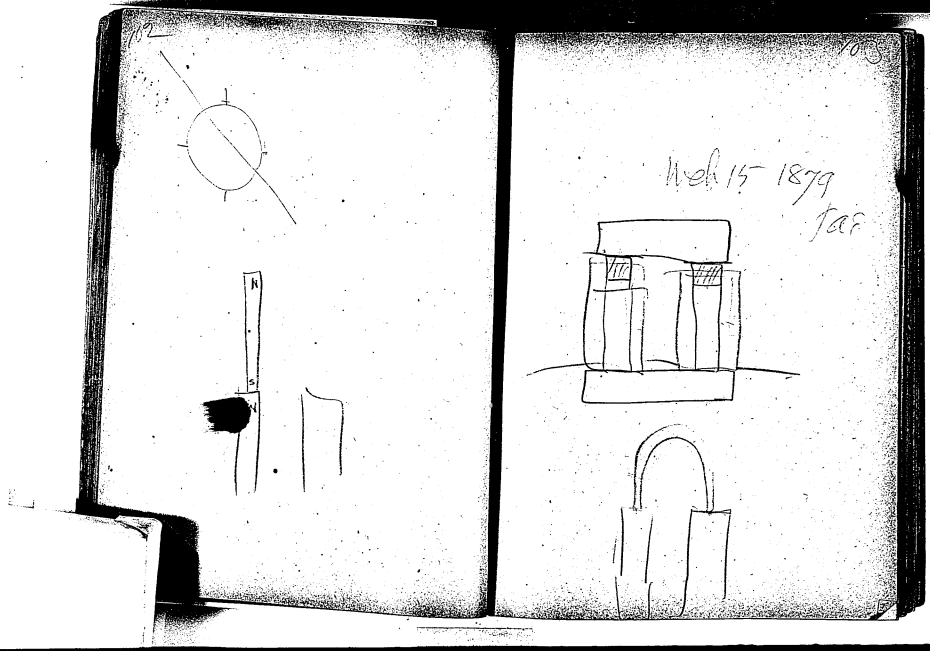
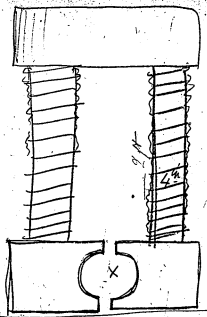


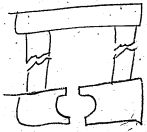
Mch 15 1879
Jae


N
S
W
Week 15 1879
Jar



Models
1879
THE

X is size of small shell



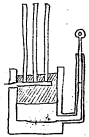
106

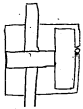
Expansion Engine

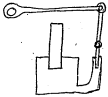
Mch 13. 1874

107

Tee



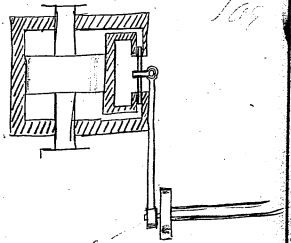




108

109

Mech 13 18-19
Jan



112

50 mm

950 mm
140
490

13.5
5
665 mm

140
18
1120
140
152
350
502

760
2
152

15 | 1405 | 93
135
56

325
560 circum
77 high

262

82.7
2
165.4

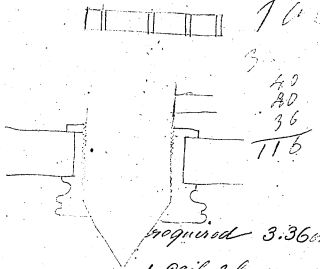
21900
77
153300
15332
1686200

1686 litres
1686 cc. estimated
capacity less glabe

255

81.2
1.6856
274200 mm³
1408 litres in pump less 15

March 13. 1879.



required 3.36 ohms

1 coil 3 layers

1 coil 3 layers 8 Turns = 11.304 ft.

33 " cut out = 373.032 ft.

No 18 wire at .232 ft pr ohm = 1.601 ohms

" 19 " same length 2.14 "

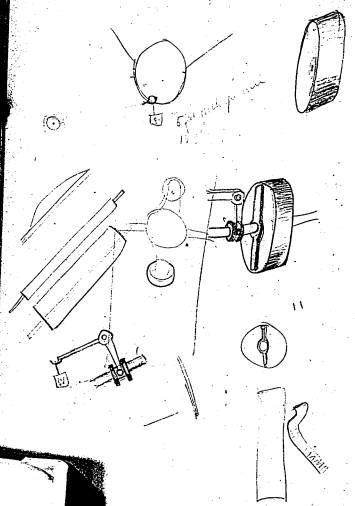
20 " 9 Turns pr. coil & 3 layer 3.52 ohms

100 coils of No 19 = 0.035 wire from

covered with silk 0.041) 9 Turns 3 layers

= 1190.6 ft 118.5 pr ohm = 10.04 ohms

~~0.04 for 10 Turns~~

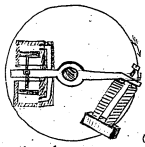


March 22 1879

Ratchet

Dynamometer

Edison thinks it a good idea to use two oil cylinders, one on each side of the lever as as to make the movement of lever more decided and slower, of course with this you would have to use longer and stronger magnets as there would be some friction on these rods, as we should have to make them oil tight — The only reason I see why this should not work satisfactorily is that the movement is too small to act properly, this however may not be the case



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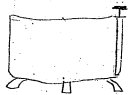
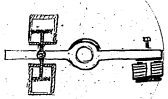


Mar 22 1879

Joe



Kirby Lashcups

18

3 T 3 4

March 22 1879

100 dollars
100 shares.

Fair

Bell Co = 33 1/3
Bailey 33 1/3
Edison 33 1/3

Edison { Pirskay
Bowman
Edison

33 1/3

Bailey gives up (Parker & E) for Colonel
20 per cent =

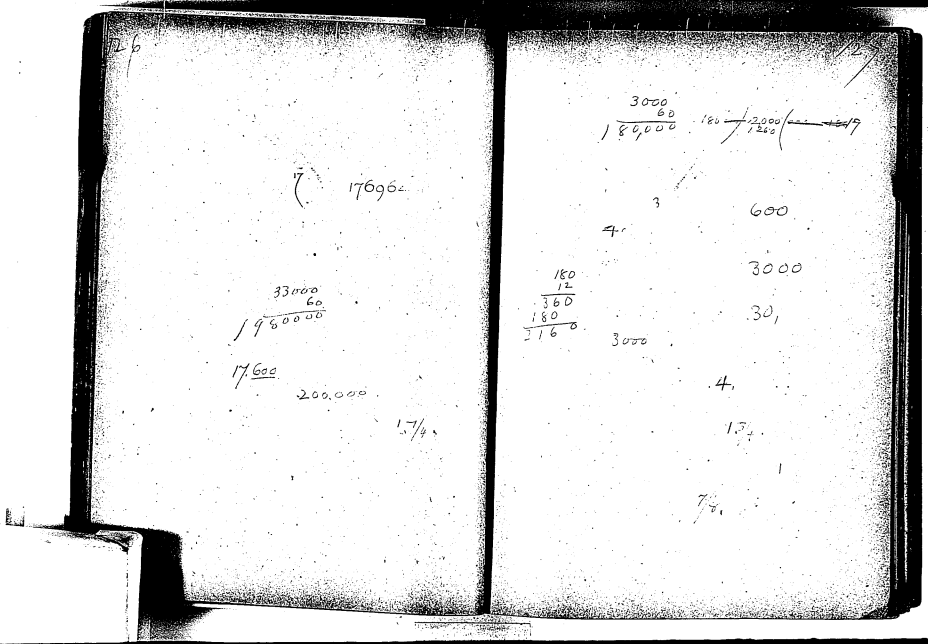
Bell Co 33 1/3
Edison Amend 33 1/3
Bailey & Parker & E 33 1/3 ÷

March 22 1919
TAE

Proposed =

British Tesla Co -

Capital Stock = £200,000,
for patents £75 and = additional
£10 000 in cash =



George

George

Geor

7.4.39 Ge'. 1. George

George

George Goddard Geo G

G Ge Goddard

Goddard Goddard

Ge George Goddard Goddard

Goog Goddard

Dr. Geo

G. P. Lewis Goddard

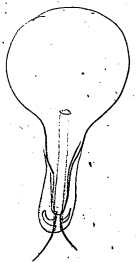
Norman Green Geo. Goddard

Tracy

Goddard Goddard Goddar

Goddard Tracy Goddard

Goddard



Portland

Portland Portland

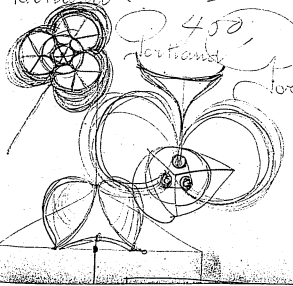
3.70

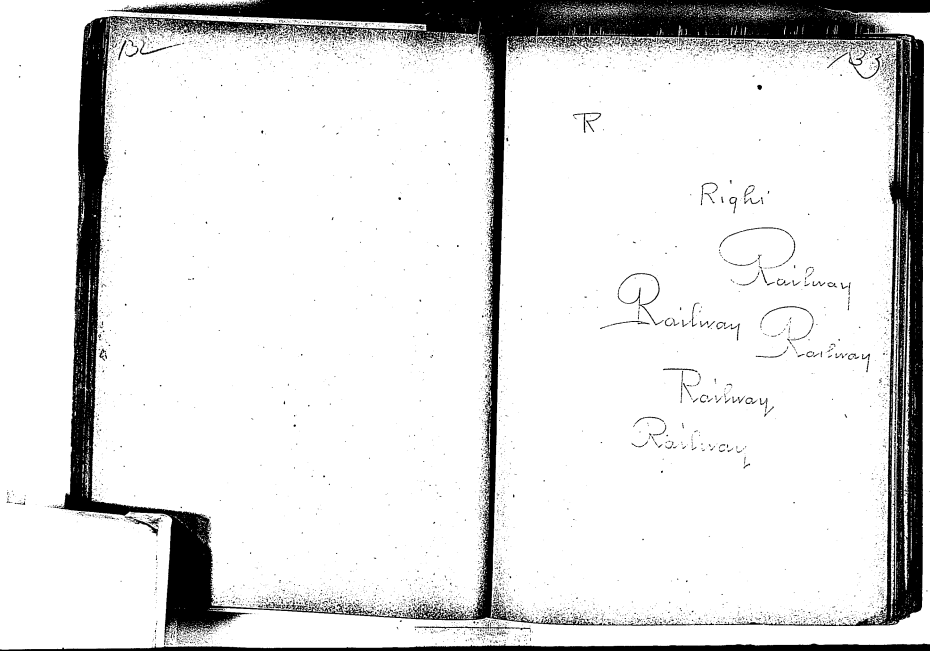
Portland Portland

450

Portland

Por



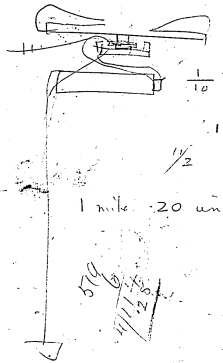

R
Right
Railway
Railway
Railway
Railway
Railway

134

135

Mch 22 1879

Jac

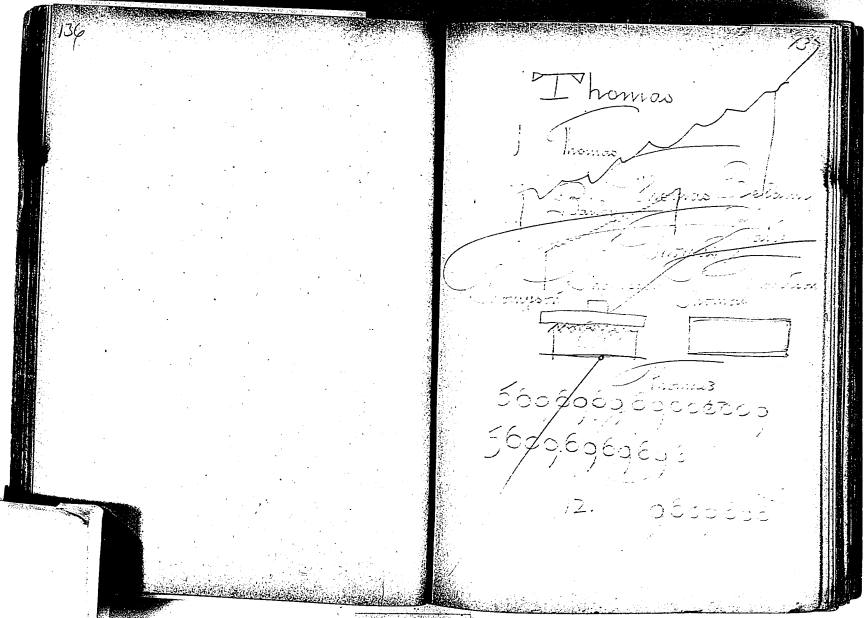


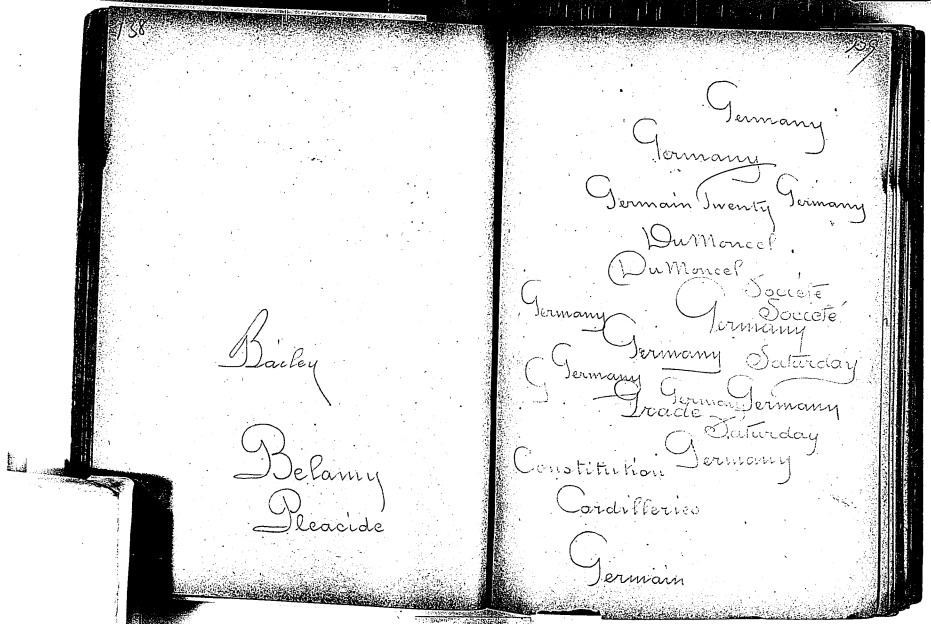
1/10 1

1 10

1/2 5

1 mile 20 units


136
137
Thomas


158
Bailey
Belamy
Pleacide
159
Germany
Germany
Germain Twenty Germany
Du Moncel
Du Moncel
Germany
Société
Douceté
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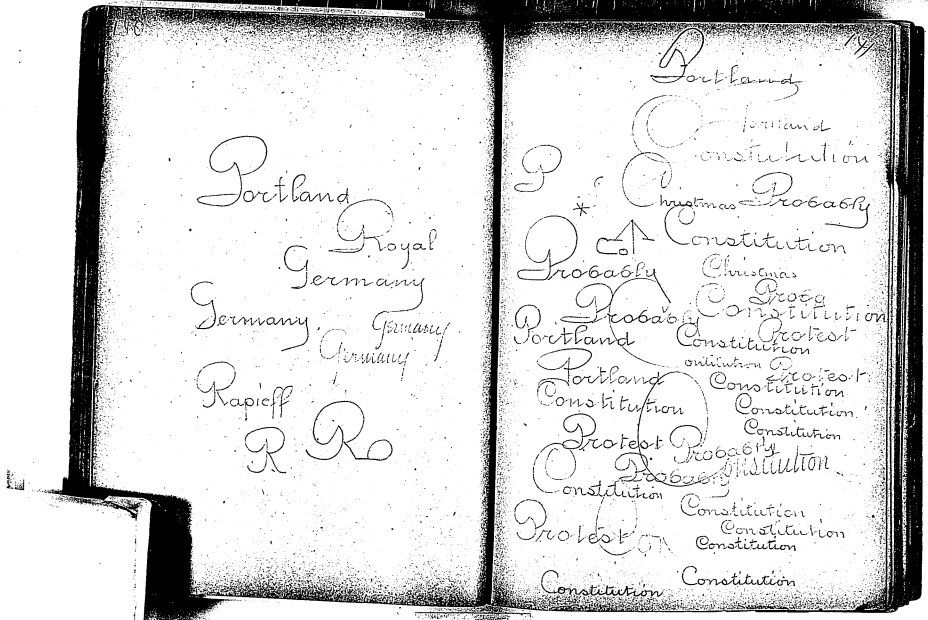
Saturday
Germany
Constitution
Cardifferies
Germain


Portland
Royal
Germany
Germany
Germany
Germany
Rapieff
R R
Portland
Portland
Constitution
Christmas
Probably
Constitution
Probably
Christmas
Probably
Constitution
Probably
Constitution
Portland
Constitution
Protest
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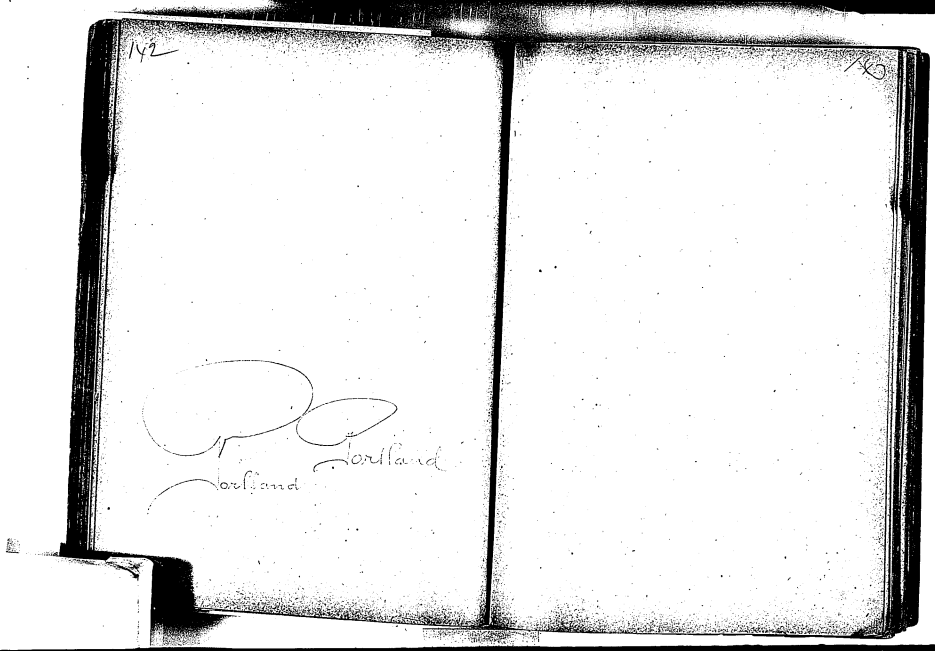
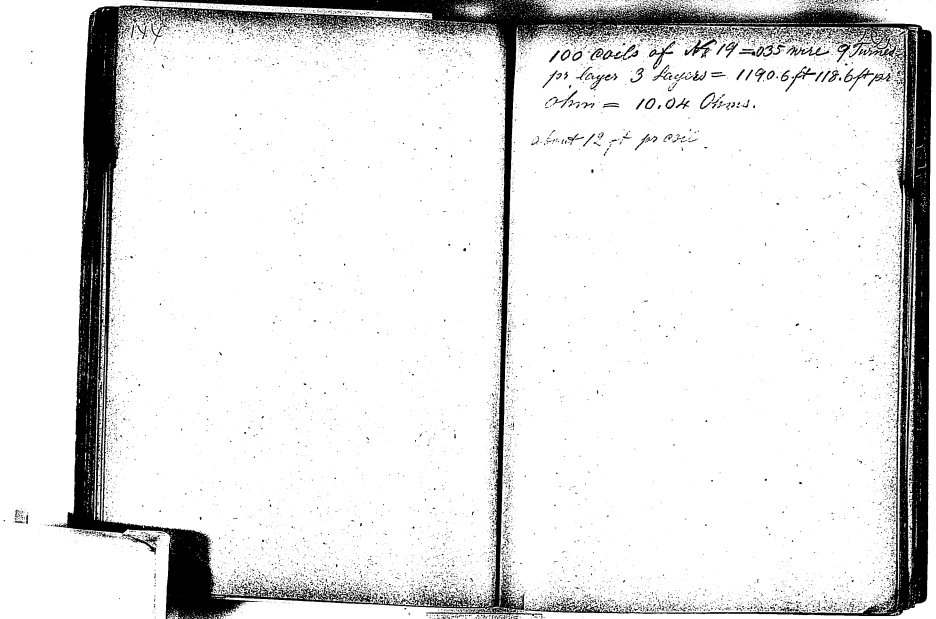
Constitution
Protest
Probably
Constitution
Constitution
Constitution
Constitution
Protest
Constitution
Constitution


142
Norland
Norland


100 coils of #19 = 035 wire 9 turns
pr layer 3 layers = 1190.6 ft + 118.6 ft pr
ohm = 10.04 Ohms.
about 12 ft pr coil.

10 ohms

8 ft lbs per $\frac{1}{16}$ = 12/16.
hence 100 ft lbs
But 1 Pump 5/16 requires only 40 ft lbs —

or .8 . . 8 50

25 ft lbs per ohm

—

3/4 of an inch.

4 of 4 ohms 3/

9
4
36 inches

4 Pumps 3/4 inch radiating surface
4 ohms — 100 foot lbs, 25 on each 3/16.
or .8 H.P.'s per $\frac{1}{16}$ —

8 ohms, 50 foot lbs,

25.
4

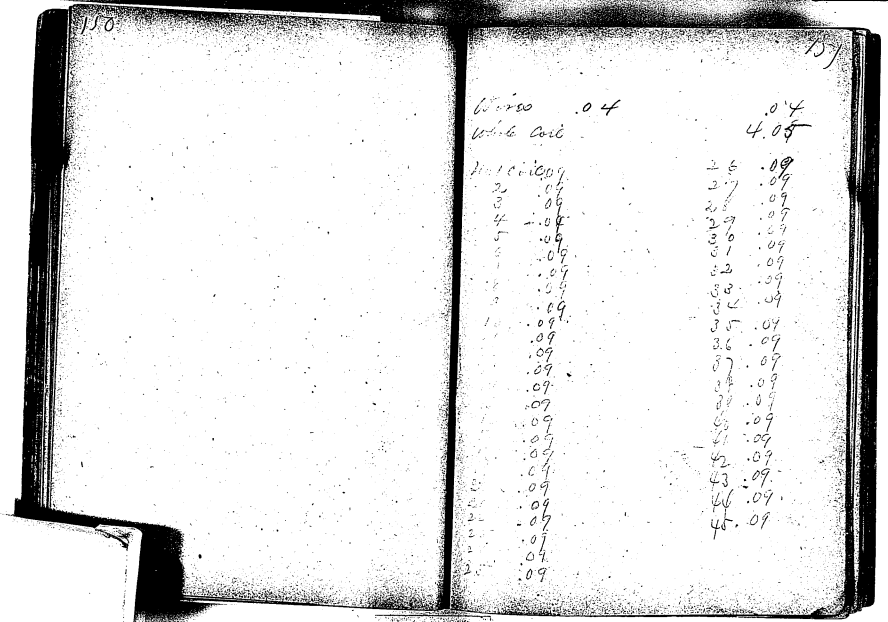
4 Lamps 4 ohms or
1 " 4 ohms
5 " 5 ohms
1 " 5 ohms
6 " 6 ohms
1 " 6 ohms

100 Lamps 100 ohms total or 1 ohm each
1 Lamp 100 ohms

4 Lamps 4 ohms 100 ft lbs or 25 ft lbs per Lamp
1 Lamp 16 ohms. 25 ft lbs

8 Lamps 8 ohms ~~25 ft lbs per Lamp~~
1 64

10,



150

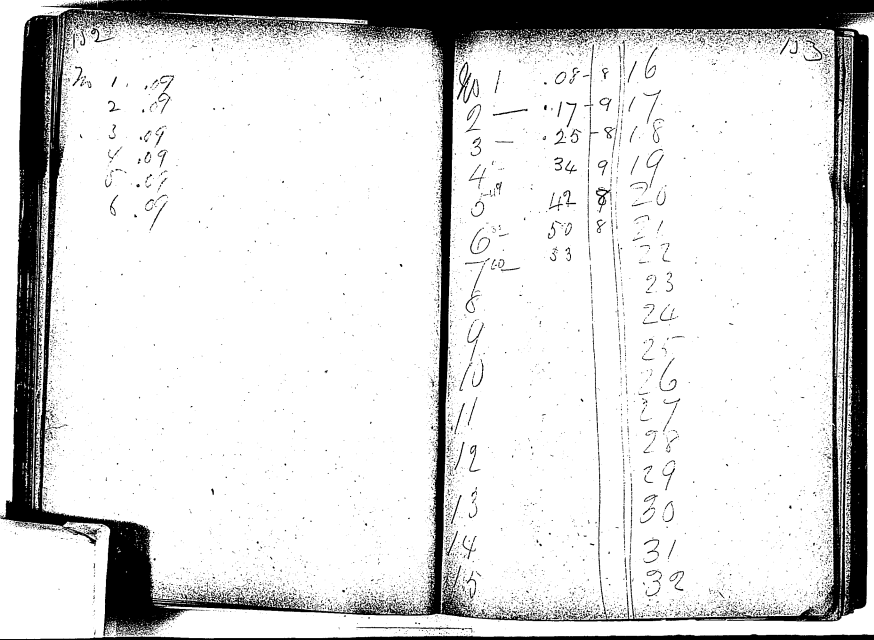
151

.04

.04

4.08

.09
.09
.09

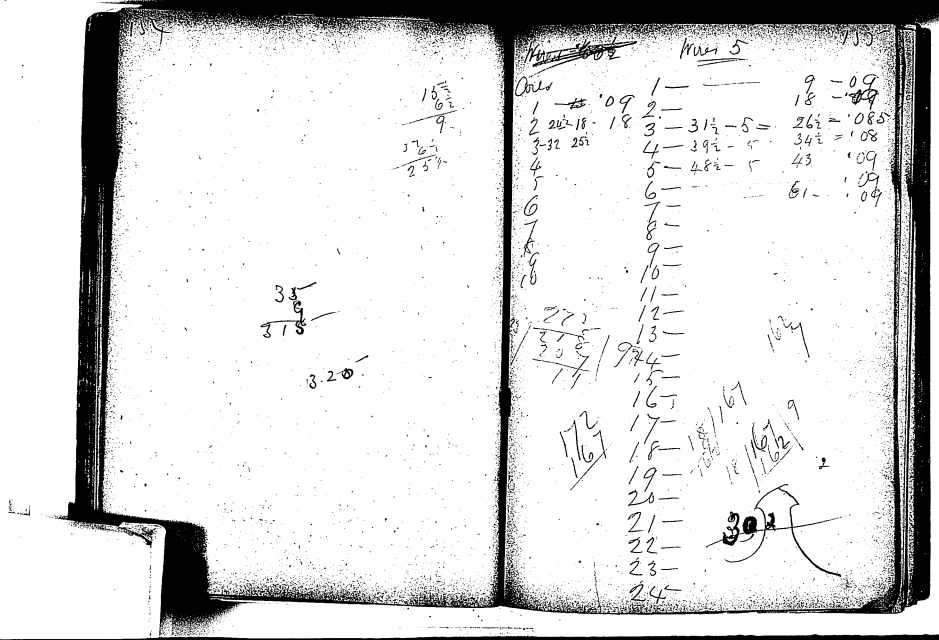


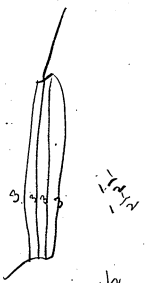
152

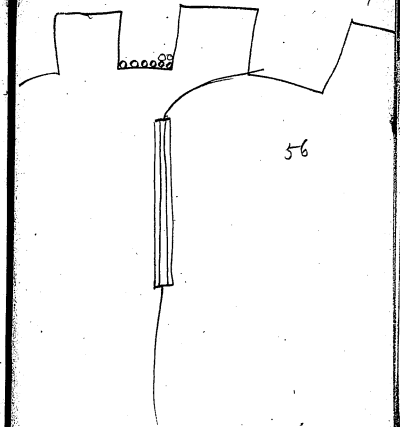
1	.09
2	.09
3	.09
4	.09
5	.09
6	.09

153

1	.08	8	16
2	.17	9	17
3	.25	8	18
4	34	9	19
5	42	8	20
6	50	8	21
7	59		22
8			23
9			24
10			25
11			26
12			27
13			28
14			29
15			30
			31
			32




3
1 1/2
1/2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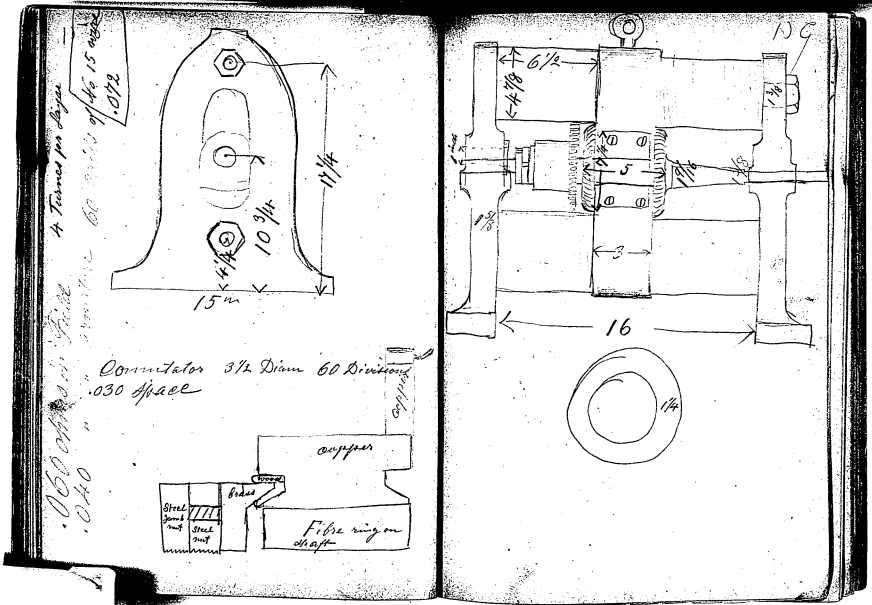
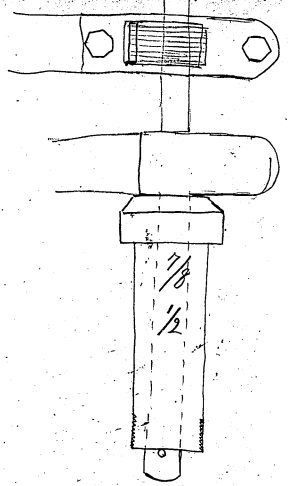
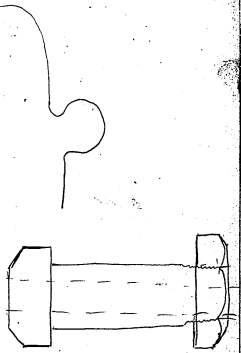
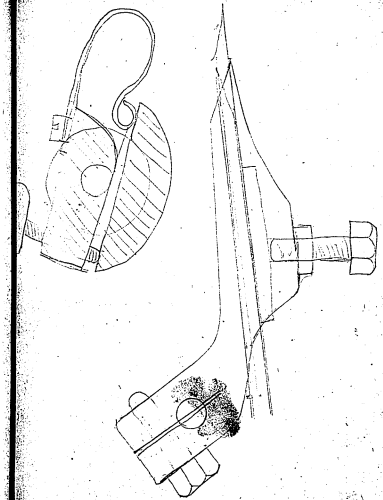
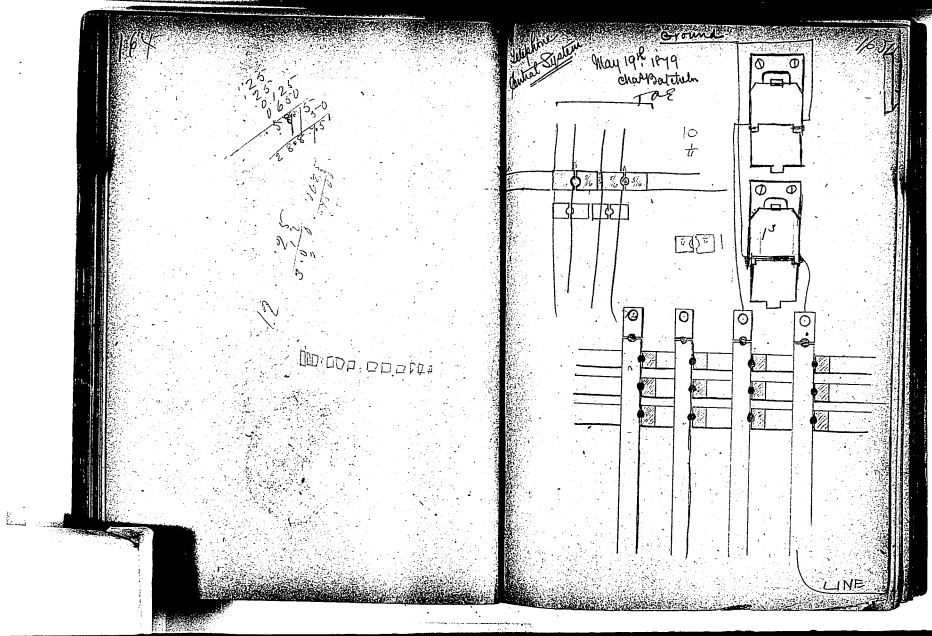
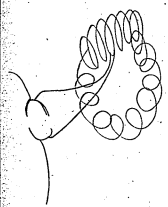

4 Turns per Layer
.060 apart on Fibre
.040 " " Armature
.032 wire
11 1/4
10 3/16
4 1/2
15/16
Commutator 3 1/2 Diam 60 Divisions
.030 Space
Brass
Steel Bush nut
Steel nut
Brass
Fibre ring on shaft
6 1/2
4 1/16
1 1/8
5
3
16
1/4
NG

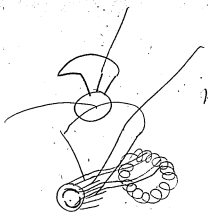

1/8
1/2






Telephone
Central Station
May 19th 1879
Scale 1 Inch
GROUND
LINE





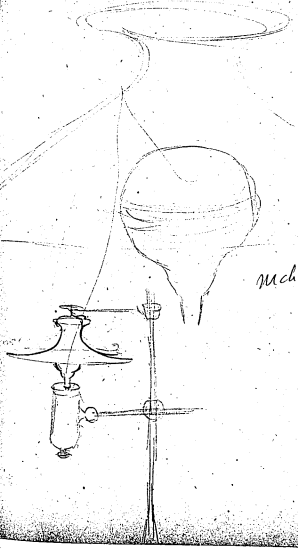
March 1879
Tail

168

Herald
Arctic Expedition Enc

169

1 Edison Faradre machine
1 Wallace Lamp
1 Candle holder for Carbon
1 Belt
1 Pulley Mch 19 1879 JAE
6 Laces
1 Edison Lamp
2 Oil cups
20 ft Connecting wire



March 19 1879
TAE

172

1000 × 100 ohms

100 lamps @ 1 ohm

100	1 =	1
	2 =	.25
	4	.125
	8	.0625
	16	.03125
100	32	.011

25 / .0100000 / .0005 / 1000 / 10000

	1 =	100 ohms
	100 =	1 ohm
	200	.5
	400	.125

.100 500 2 5 5

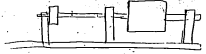
.0.005 / 2 5 / .0025 / .0010 / .00125 5 5 0 0

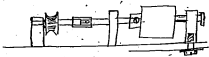
	1 =	100 ohms
	10 =	10 ohms
	50 =	2 ohms
	100	1 ohm
	1000	0.2
		.1

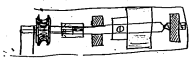
Hand micrograph recorder

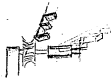
July 12, 1909

Charpentier



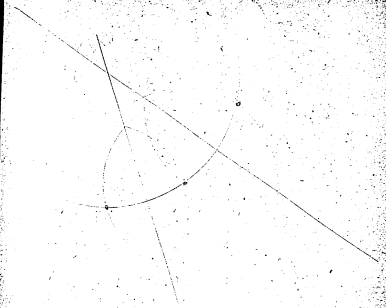


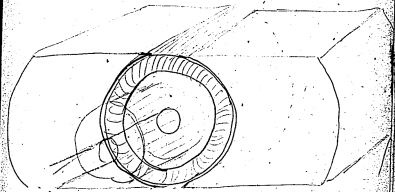


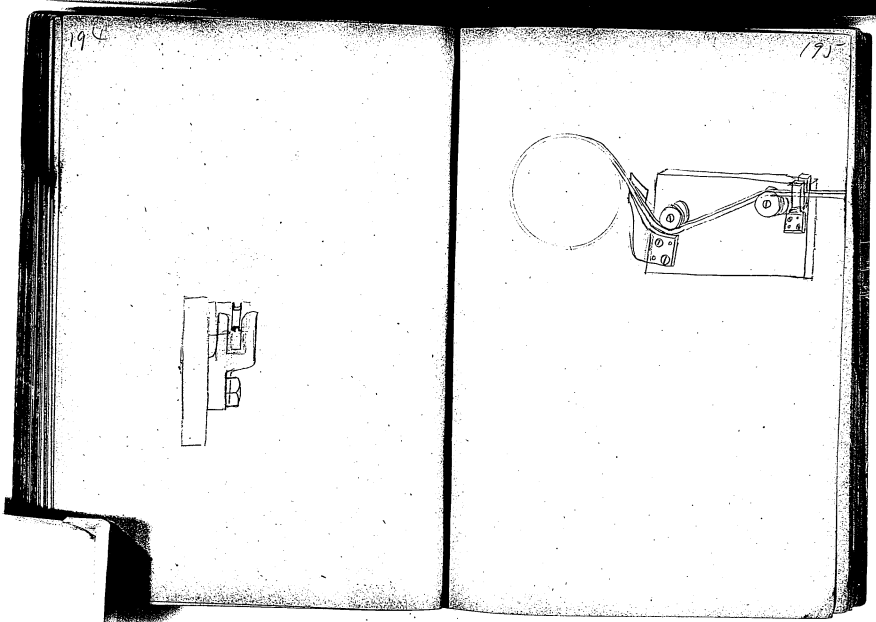


15 | 2-18 (14.5
15
68
60
8

14.5
6
870



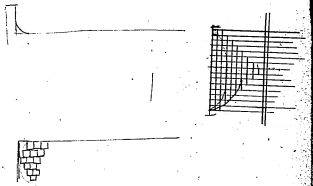


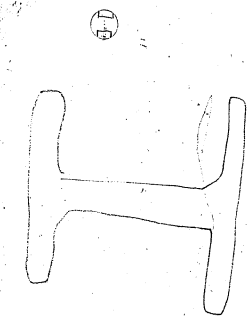


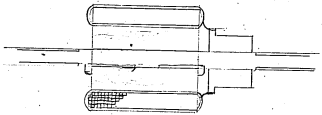
196

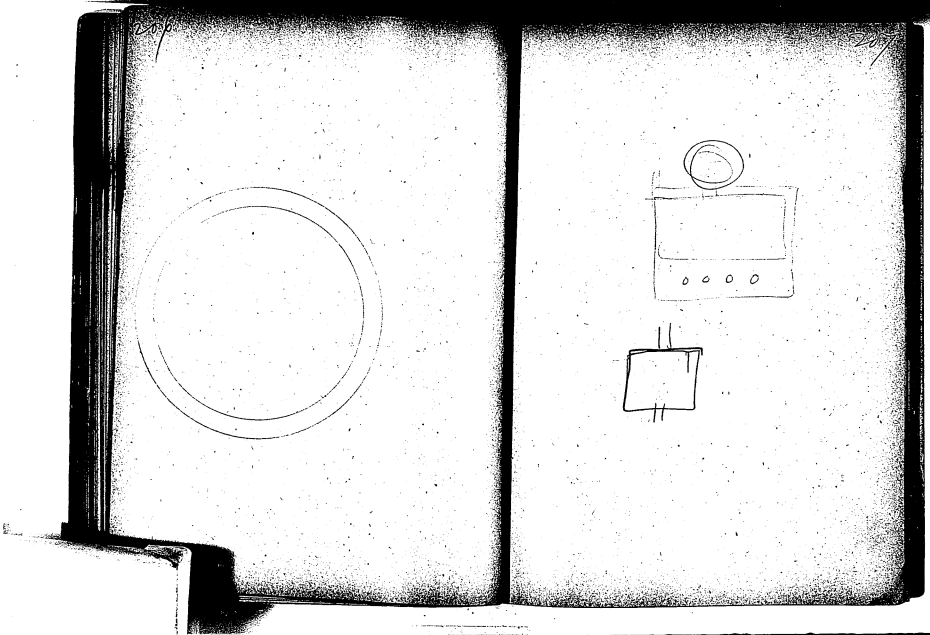
45

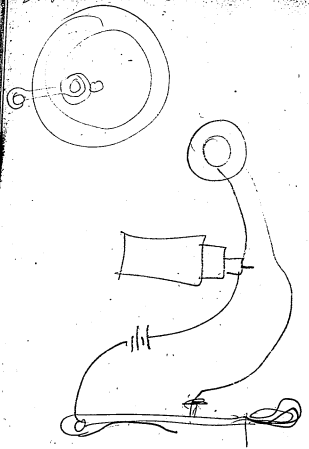
197

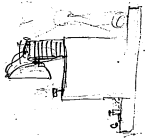


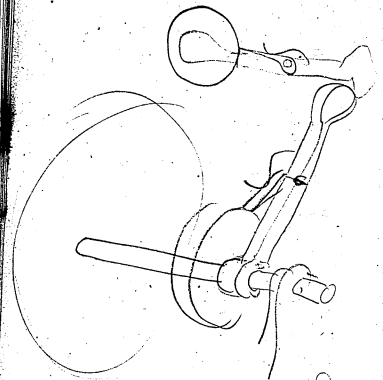


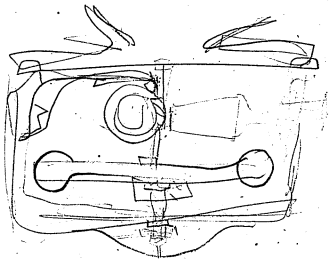


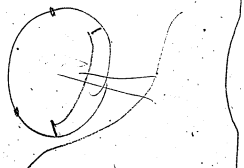


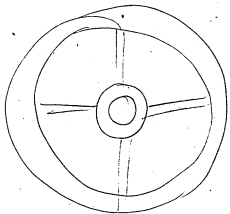


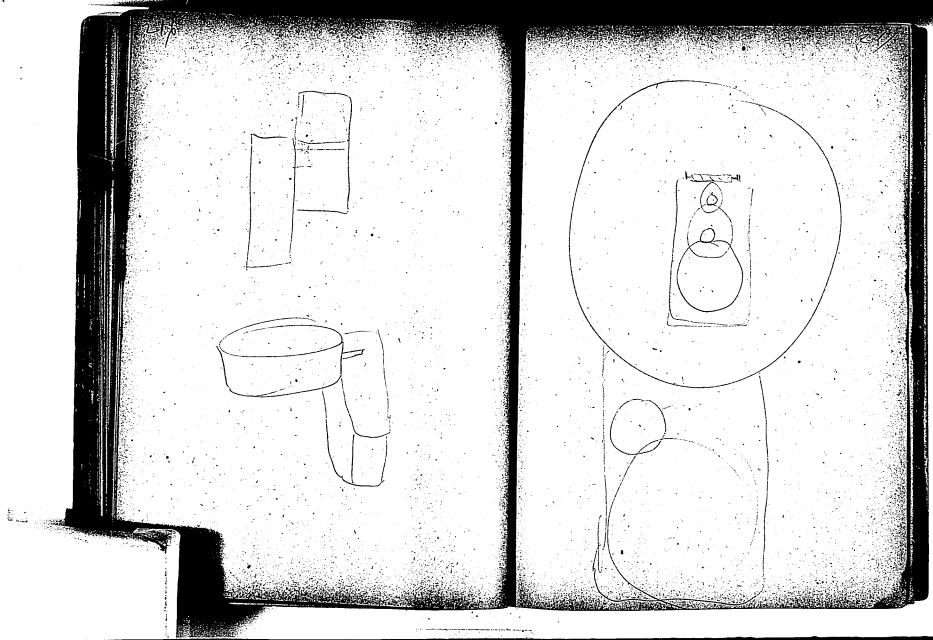


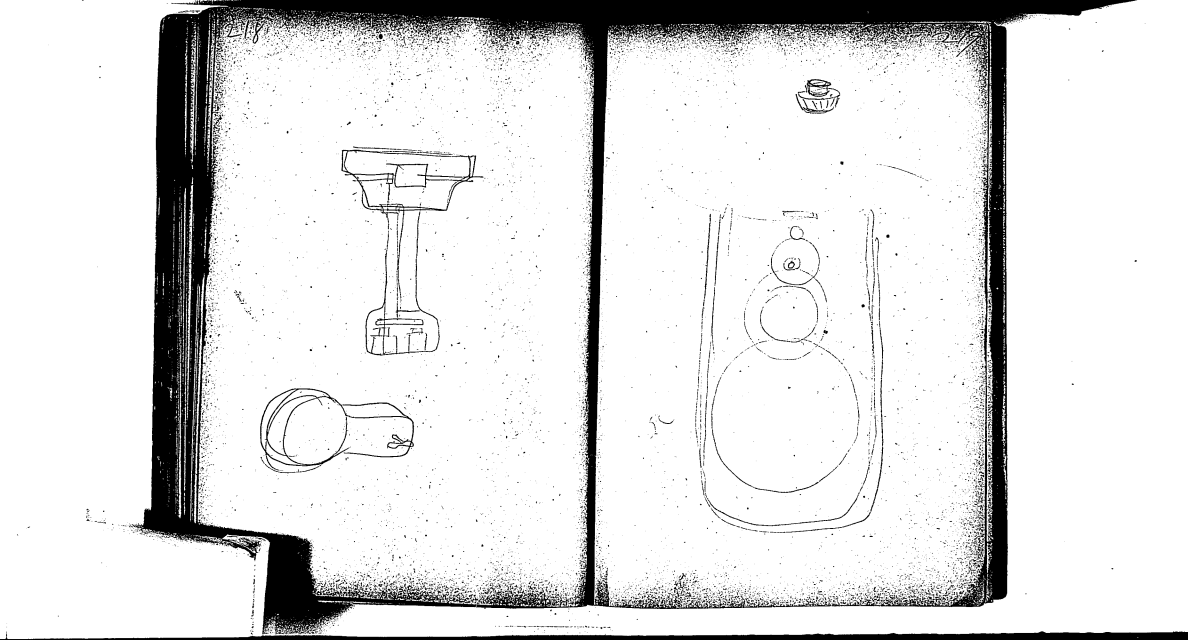












220

33.000 / 1.000.000

6 / 8.000.00

33 / 133.333 | 40 H.P. one hour

132

133

4 / 8 I 10

2.2 cts per hour per H.P.

2.2 cts per hour per H.P.

2. cts per

2.2 c

2 cts per hour

16 365

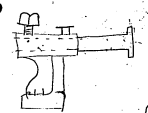
16

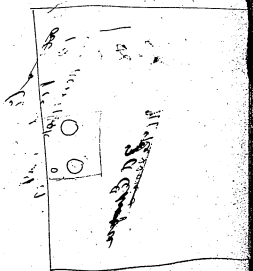
219 0

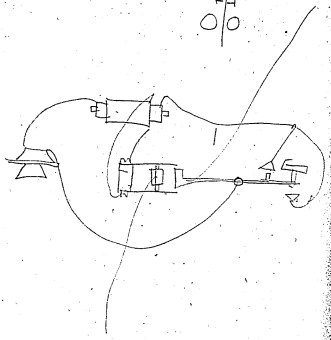
365

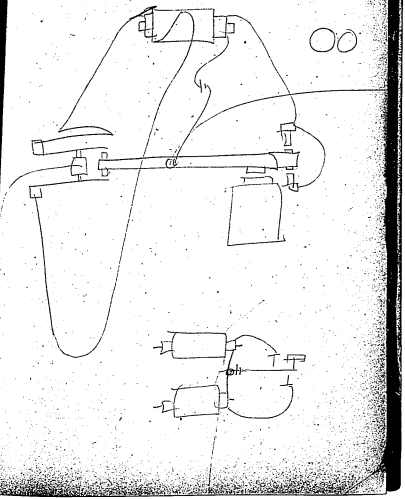
$38.40

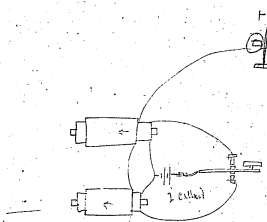
8 hours a day

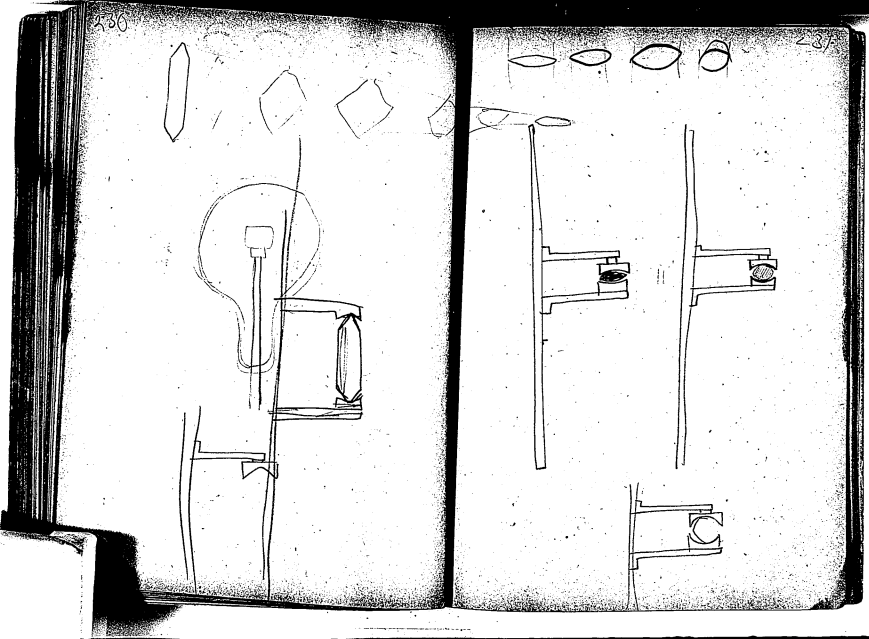


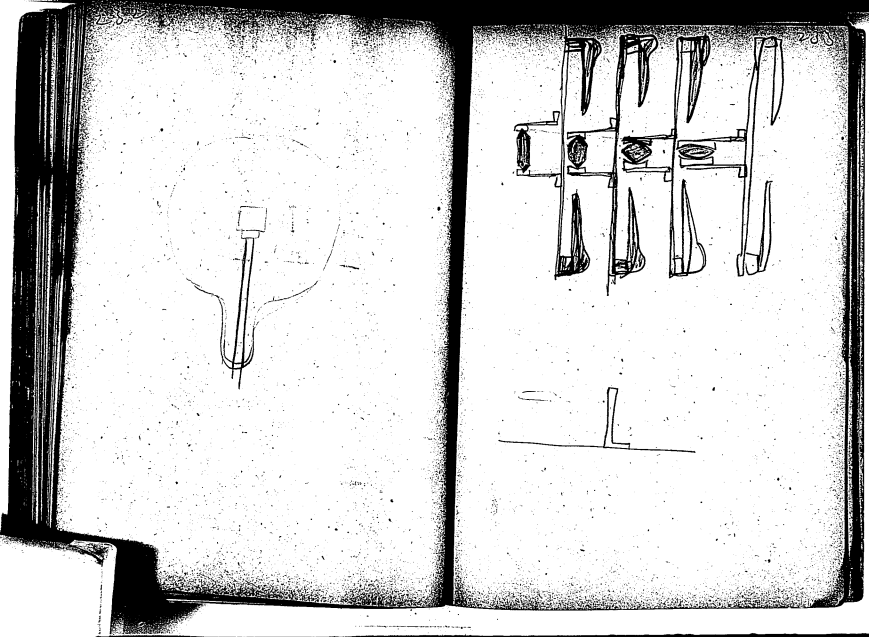


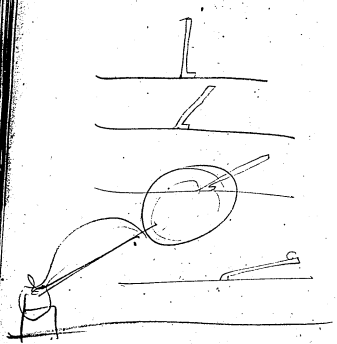


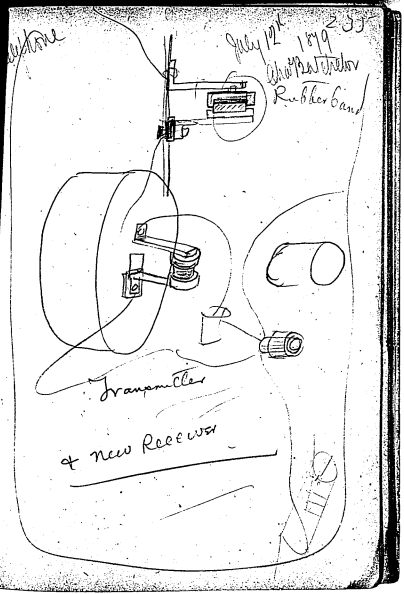



2 collant
Rés.

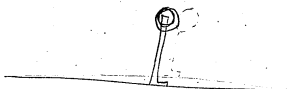


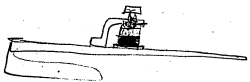


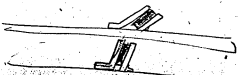



July 12th 1919
Rubber Band
Transmitter
& new Receiver

20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1



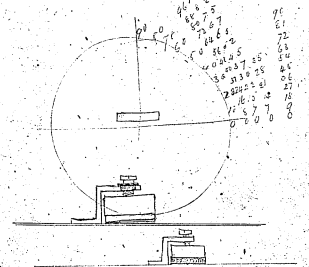


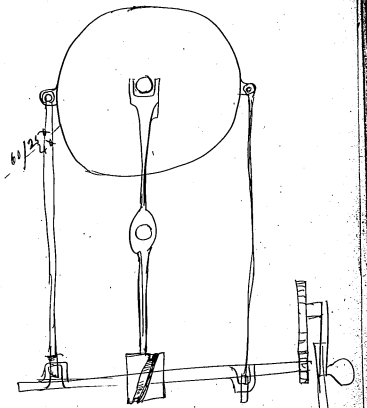


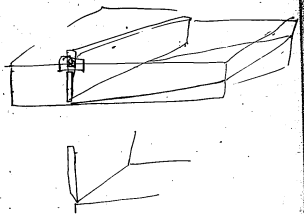
Find Hopkins microphone in Streator American

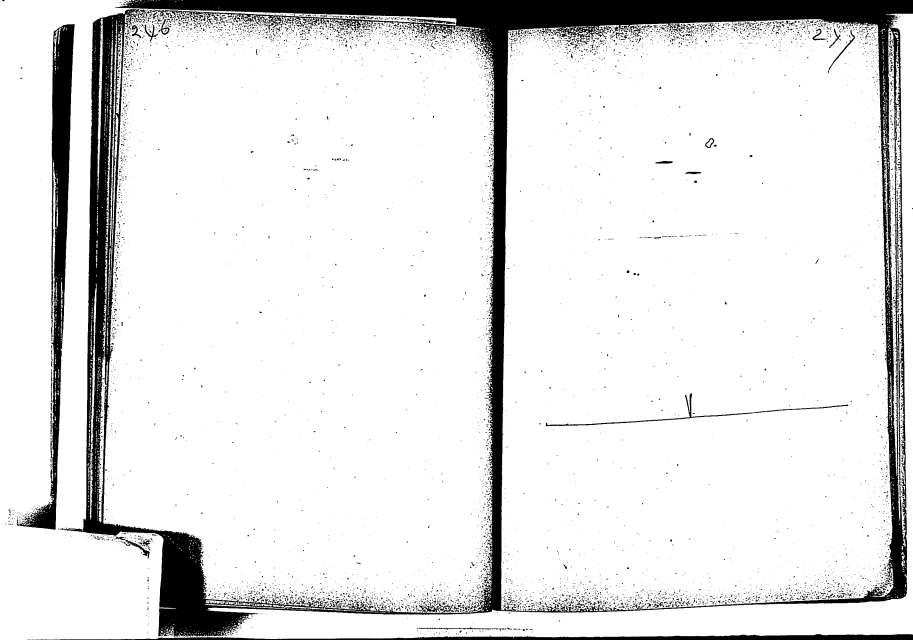
Find Houston Thompson Wyeatt

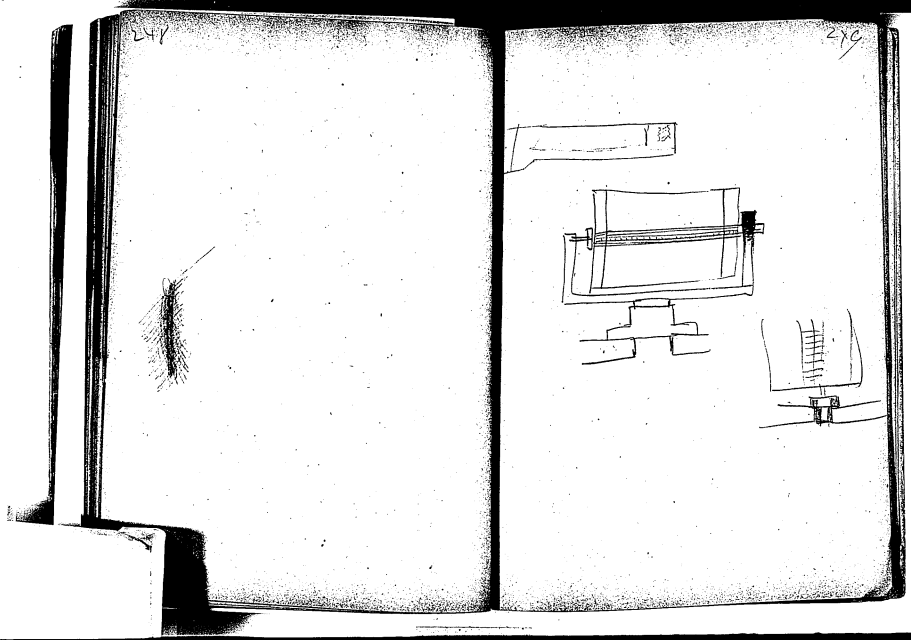
Find Hughes microphone

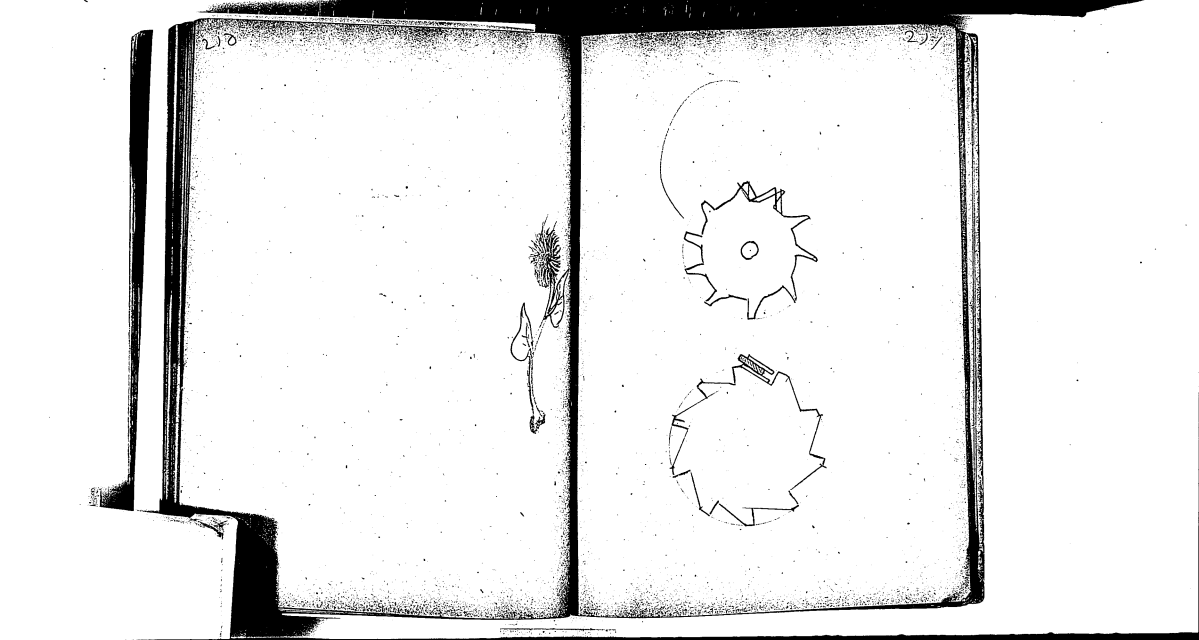


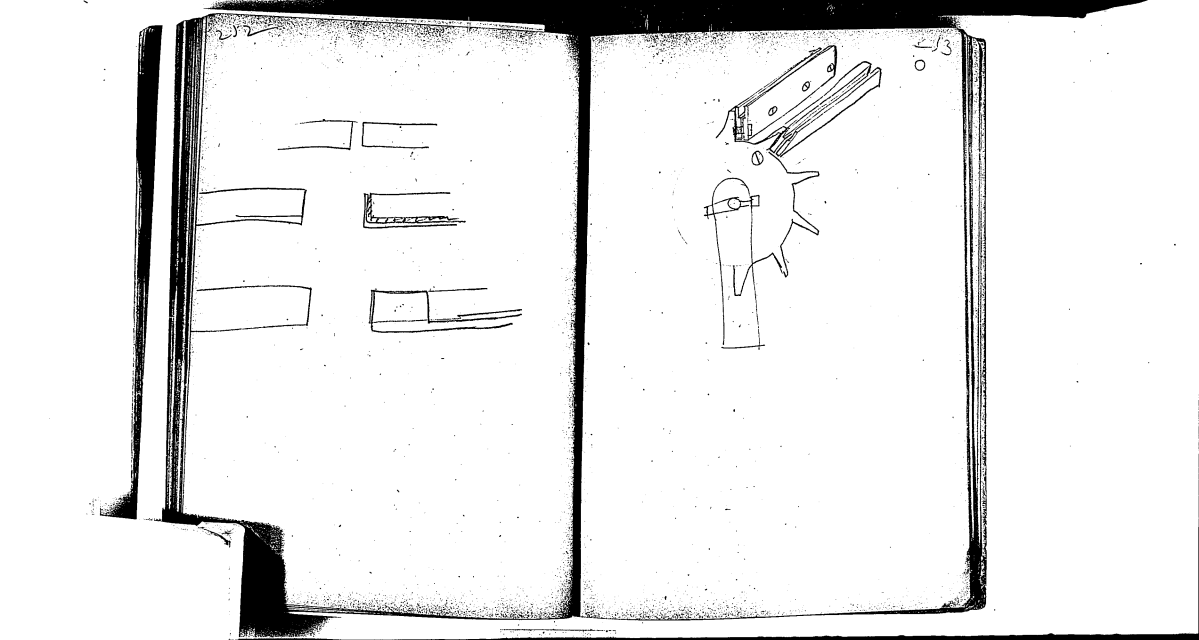

61/2"

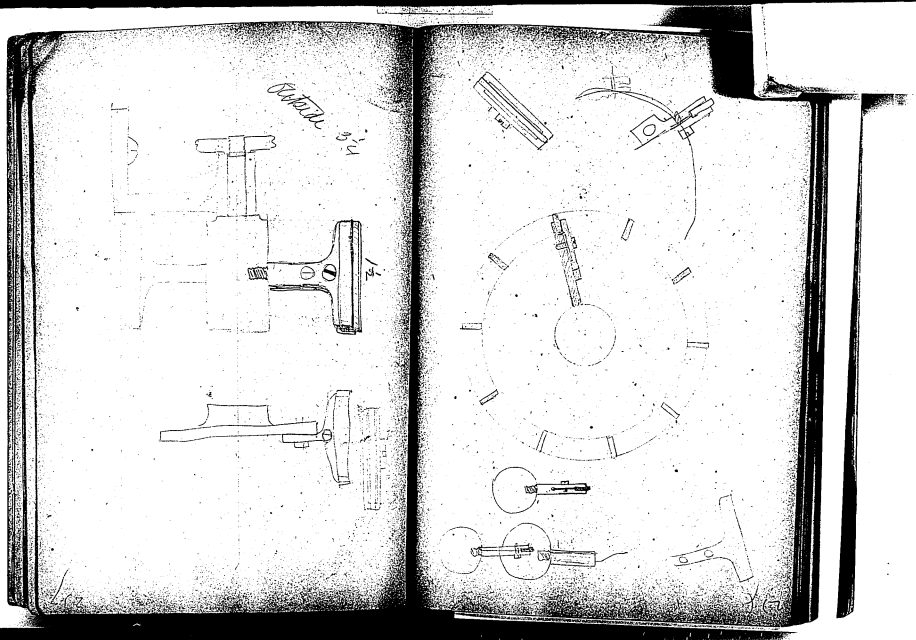












5 miles 4.33

17.

.3125

$\frac{1}{8}$

17 feet miles 100 ohms Brass
when hot .010

.028

.007 = 8.66

.028 × .028

6 layers 26 turns = 156 turns of
.5 = 78 ohms = 6½ feet

7 layers of 29 turns = 203 turns of
.5 = 101 = 8.5

.004 =

6½ feet 250 ohms
9 feet 351 ohms

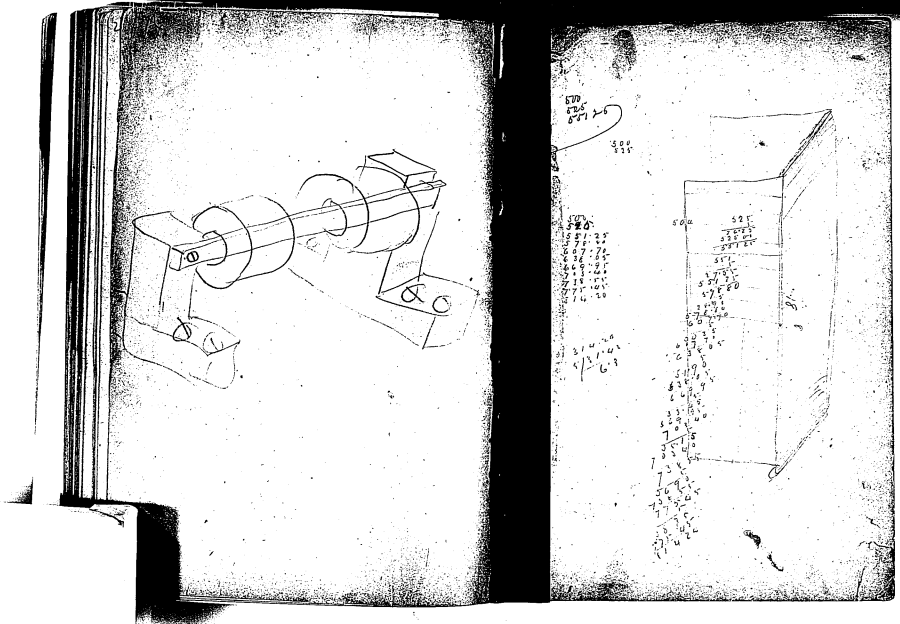
.006

10 layers of 44 turns of .5 =

10 × 44 × .5 = 440 × .5 = 220 =

18½ feet

357
351
6



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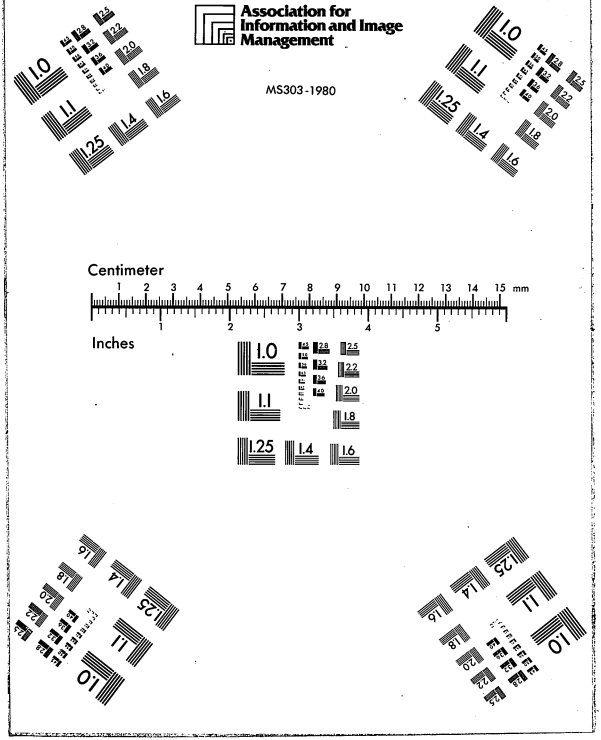
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